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National Air Pollution [illegible]
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BITUMINOUS COAL RESEARCH, INC.
SPONSORED RESEARCH PROGRAM

AN EVALUATION OF COAL CLEANING PROCESSES AND TECHNIQUES FOR REMOVING PYRITIC SULFUR FROM FINE COAL

Final Report
(BCR Report L-362)
February, 1970

I. Introduction

A. Background

During the combustion of fossil fuels, sulfur oxide compounds are formed and released to the atmosphere. Where it is feasible to physically remove pyrite from coal in significant quantities, the amount of sulfur oxide produced from coal firing can be reduced.

Initial investigations indicated that little information existed on the washability of coals that were mined primarily for use in power generation. To eliminate this deficiency, contracts were awarded to the United States Bureau of Mines, the Illinois Geological Survey, and Commercial Testing and Engineering Company to develop washability data on these seams.

The washability studies were rather unique in that they were to develop information on pyrite liberation at various stages of crushing and grinding rather than developing washability data on the various sized fractions as mined so that the proper sized splits could be made and the proper cleaning equipment and separating gravity selected.

On June 1, 1967, Bituminous Coal Research, Inc., was awarded a contract, No. PH 86-67-139, to develop additional data on selected coals.

The objective of the initial work undertaken by Bituminous Coal Research, Inc., was twofold; first, to extend the washability data to finer sizes of coal, and second, to evaluate coal cleaning methods and techniques for removing pyritic sulfur from the fine-sized coal. From BCR's previous work with pyrite removal from finely sized coal, two size consists were of interest in the washability studies.

The first was the 30 mesh x 0 size as this was the lower limit in sizing that would contain a size range of pyrite typical of a utility pulverizer's recycle load. It is this recycle material that can possibly be removed from the utility pulverizer, wet-cleaned to remove the pyrite, and the clean dewatered coal reinjected into the feed to the pulverizer without thermal drying.

The second size range of interest was each coal's "as fired," or p.c. grind. It is at this stage of pulverization that maximum pyrite liberation occurs, insofar as the coal's present utilization is concerned. Therefore, it is obvious that the maximum degree of potential pyrite removal has also been reached with each coal's p.c. grind.

The evaluation of coal cleaning methods and techniques was limited to studies involving the coarser, or 30 mesh x 0, grind.

The results of the work completed during the first year and a half of the program, or through December 31, 1968, were reported to the National Air Pollution Control Administration in an interim report dated September 1969 entitled, "An Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal," Contract No. PH 86-67-139.

This report is concerned with the results of the work completed during calendar year 1969 from the ongoing study.

B. Objective

The objective of the work undertaken during calendar year 1969 was not significantly different from that for prior work already described in the introduction.

The investigation into the pyrite liberation and removal characteristics of U.S. coals, when pulverized to the two fine grinds of interest, was continued.

Studies were also continued on two of the three fine coal cleaning devices, the concentrating table and the compound water cyclone, to further ascertain their potential for removing pyrite from fine sized coal.

Detailed work was undertaken to determine the potential of fine cleaning for preparing a concentrated grade of pyrite, as removed from the fine coal, in quantities commensurate with the total amount available for removal.

In line with the total seam utilization concept, where only the obvious refuse would be discarded, the use of the intermediate fractions lying between the clean coal and the high grade pyrite was studied.

C. Approach

Twenty additional coals were evaluated under Phase I of the program, Pyrite Liberation and Removal Characteristics. The coals were from three new geographical areas, the South, the Far Midwest, and the Far West. Each coal was pulverized to a topsize of 30 mesh and to its p.c. grind; each grind was subjected to a float-sink separation at a 1.60 specific gravity in the centrifuge; and sulfur reduction calculations were made for both total and pyrite sulfur.

Three Far Midwestern coals were subjected to two-stage cleaning studies under Phase II of the program, Equipment Evaluation, to determine the suitability of the compound water cyclone and the concentrating table for cleaning these coals at a topsize of 30 mesh. Each coal was rough cleaned on the concentrating table at a 3/8-inch topsize to remove the obvious impurities. The coal fraction was crushed to a topsize of 30 mesh, and recleaned using both the compound water cyclone and the concentrating table as the prime cleaning devices. These three coal samples were obtained by BCR personnel.

The pyrite concentration potential of two of the three Far Midwestern coals was also studied in Phase IV, together with four coals supplied by the U.S. Bureau of Mines. In these Phase IV studies, Pyrite Concentration Characteristics, the raw material for testing was obtained by accumulating the heavier gravity refuse during the rough cleaning of the 3/8 inch x 0 coal on the 1/4-size concentrating table. This heavy refuse was subsequently pulverized to minus 30 mesh and the pyrite concentration was undertaken using a 15S metallurgical concentrating table. The 15S table has approximately one-fourth the surface, or cleaning area, of the quarter-deck, coal cleaning concentrating table. To simulate the recirculation of middling product that had been further reduced in size to increase pyrite liberation, the middling material from the process was collected, pulverized to minus 60 mesh and recleaned on the same 15S concentrating table.

During the course of the three concentrating table tests mentioned--the first to produce a low sulfur clean coal product and the remaining tests to produce a pyrite concentrate in two stages--numerous high-sulfur, high-ash fractions containing significant quantities of combustible material were also collected and analyzed. Sufficient data were obtained so that an initial evaluation could be made of the potential use of these fractions in a high sulfur combustor.

II. CONCLUSIONS

A. Phase I Evaluations

The coals evaluated during calendar 1969 were quite different from the 70 coals evaluated during the preceding 18-month period. The majority of the R.O.M. coals was low in pyritic sulfur and little improvement could be made in sulfur reduction by gravity separation. The coals high in pyritic sulfur were also high in organic sulfur so that the total sulfur reductions obtained were not as impressive as previously reported reductions. If an overview of the effects of fine grinding on pyrite liberation is to be obtained on U.S. coals, such data are necessary.

A general conclusion on the Phase I work is that additional data should definitely be obtained on coal seams and/or areas that have, with limited data, shown potential with this approach to air pollution control.

B. Phase II Evaluations

Results of the Phase II Coal Cleaning, tests on the concentrating table with the three Midwestern coals tested did not fully correlate with the results of the Phase I evaluations. The two coals containing relatively high organic sulfur did not clean to the degree initially indicated. The primary reduction in the two-stage cleaning occurred in the coarse (3/8 inch x 0) cleaning on the concentrating table, indicating that the majority of the pyrite still associated with the coal was very fine and not easily liberated by further size reduction. It is assumed that this extremely fine pyrite, if liberated when the coal is pulverized to a topsize of 30 mesh, falls into the size range where poor separating efficiency is obtained even with the concentrating table. The centrifuge, utilized in the float-sink work of Phase I, is highly efficient in removing this extremely fine pyrite from even the p.c. grind, where a high percentage of the test material is finer than 200 mesh.

When the compound water cyclone was utilized as the second stage cleaning device for the minus 30 mesh coal, results were not improved over those obtained in the initial work on the program, when we concluded:

"It is our opinion that the pyrite was much finer than the coal, relatively speaking, thus making separation in the cyclone impossible. A possible alternate to the present compound water cyclone test procedure would be to separate the feed into two size fractions, using a rapped sieve bend with a 200 mesh aperture, and processing each fraction independently in the compound water cyclone."

It is recommended that further test work utilizing the concentrating table (Phase II) be continued in conjunction with the Phase IV evaluations to be discussed.

C. Phase IV Evaluations

Excellent results were obtained in the Phase IV, Pyrite Concentration, evaluations, and it is recommended that this work continue. Much of the success of the pyrite removal program will eventually rest with the degree of success obtained in utilizing both the maximum Btu's in the R.O.M. coal and the recoverable sulfur, whether it is recovered by physically removing it as a high grade pyrite concentrate, by recovering the SO_2 from the combustion of the high ash, high sulfur constituents in the coal, or by a combination of the two processes.

The data indicate that a high grade pyrite concentrate can be made by the two-stage processing of the pyrite-rich refuse from the coal cleaning operation. In actual operation, the second stage concentration of the pyrite would be accomplished on the same cleaning unit as the initial concentration by pulverizing the middling and recirculating it.

Additional information should also be obtained on the combustion characteristics of the high ash, high carbon material produced from the cleaning process. If combustion equipment is to be designed to burn this high ash, high sulfur coal, it is imperative that the combustion characteristics of this material be determined. It is, therefore, recommended that ash fusion, spectrographic analyses, and Btu values be determined by adding these tests to the existing procedure.

III. PHASE I EVALUATIONS

A. Test Procedure

The test procedure utilized for the twenty coals was identical to the procedure described in the initial interim report submitted to NAPCA by Bituminous Coal Research, Inc., dated September 1969. The test procedure, in brief, consisted of the pulverization of small representative samples of the R.O.M. coal as received from Commercial Testing and Engineering Company to (1) a topsize of 30 mesh and (2) the coal's p.c. grind. Each sample was then separated into a clean coal fraction and a refuse fraction at a 1.60 specific gravity in a centrifuge. Total sulfur and pyritic sulfur analyses of the "as received" R.O.M. coal and the clean coal, or 1.60 float material, of both the 30 mesh x 0 grind and p.c. grind were utilized to determine the percent sulfur reduction.

B. Summary of Results

The percent sulfur reductions are shown in Tables 1 and 2. Table 1 also shows the percent pyritic sulfur reduction for these coals when they were crushed to topsizes of 3/8 inch and 14 mesh as determined by Commercial Testing and Engineering Company. Table 2 shows the same information for total sulfur reduction.

Figure 1, a series of curves, shows the total sulfur reduction at 1.60 specific gravity for the 20 Southern, Far Midwestern, and Western coals as a function of topsize. This topsize ranges from Commercial Testing's 1-1/2 inch topsize down to BCR's extremely fine p.c. grind. It can be seen that at the 1-1/2-inch topsize, 25 percent of the coals tested (5 coals) could be reduced in total sulfur by 20 to 30 percent when washed at a 1.60 specific gravity. The series of curves also shows that 5 percent of the coals tested, or one coal, did not change sulfur reduction levels when it was reduced from a 14 mesh topsize to a 30 mesh topsize and is shown at the lower point common to these two curves. The highest total sulfur reduction obtained was 60 to 70 percent, with one coal, at its p.c. size. The actual reduction for this coal was 69.4 percent, as shown in Table 2 for Lot No. 2281, the Lower Spadra Seam coal from Johnson County, Arkansas.

Figure 2 combines this total sulfur reduction data with that obtained on the original 70 coals as reported in the original interim report to NAPCA dated September 1969. The curves show that the greatest total sulfur reduction is obtained when the coal is reduced in size from a 1-1/2-inch topsize. This is shown by the horizontal displacement

TABLE 1. PYRITIC SULFUR REDUCTION AT 1.60 SPECIFIC GRAVITY AS RELATED TO NOMINAL TOPSIZE OF COAL

Coal Identification Lot - Seam	Location County, State	Pyritic Sulfur, Weight Percent, Raw R.O.M. Coal	Percent Reduction at 1.60 Float CTECO 3/8" x 100 M	CTECO 14 M x 0	BCR 30 M x 0	BCR p.c. grind
2235 - Jellico	Clairborne, Tenn.	0.39	51.9	51.9	53.8	53.8*
2236 - Walnut Mountain	Campbell, Tenn.	0.42	90.5	95.2	81.0	90.5*
2237 - Swany	Marion, Tenn.	0.25	41.2	50.0	44.0	44.0*
2238 - Peabody	Campbell, Tenn.	0.15	69.2	73.3	53.3	53.3*
2239 - Laramie No. 3	Weld, Colorado	0.08	50.0	50.0	62.5*	50.0*
2240 - Bevier	Boone, Missouri	3.49	56.7	63.7	58.7	77.1
2241 - Collom	Moffat, Colorado	0.09	0.0	0.0	33.3	33.3*
2242 - Des Moines No. 1	Marion, Iowa	2.62	50.2	54.8	43.5	50.8
2243 - Lower Cherokee	Mahaska, Iowa	3.49	50.8	58.2	66.0	77.9
2244 - Cannon City	Freemont, Colorado	0.25	23.1	60.0	32.0*	44.0*
2245 - Wadge	Routt, Colorado	0.09	25.0	20.0	44.4*	55.6*
2256 - Upper and Lower Hartshorne	Haskell, Oklahoma	0.95	17.7	27.4	47.4	83.2
2257 - Sequoyha	Chelsea, Oklahoma	0.20	33.3	66.6	20.0*	30.0*
2258 - Fort Scott	Chelsea, Oklahoma	4.66	50.0	52.6	53.2	69.7
2259 - Mulkey	Macon, Missouri	2.04	58.5	64.9	74.0	86.3
2260 - Stigler	Haskell, Oklahoma	0.28	53.3	75.0	21.4*	21.4*
2261 - Tebo	Henry, Missouri	3.06	66.8	76.0	76.8	87.3
2281 - Lower Spadra	Johnson, Arkansas	3.31	27.5	43.9	64.4	85.5
2282 - Upper Spadra	Johnson, Arkansas	1.24	73.3	85.0	82.3	100.0
2283 - Charleston	Franklin, Arkansas	2.92	14.7	20.8	36.3	60.3

* Calculated values based on the assumption that all of the sulfur removed from the float fraction was in the form of pyritic sulfur.

TABLE 2. TOTAL SULFUR REDUCTION AT 1.60 SPECIFIC GRAVITY AS RELATED TO NOMINAL TOPSIZE OF COAL

Coal Identification Lot - Seam	Location County, State	Total Sulfur, Weight Percent, Raw R.O.M. Coal	Percent Reduction at 1.60 Float CTECO 3/8" x 100 M	CTECO 14 M x 0	BCR 30 M x 0	BCR p.c. grind
2235 - Jellico	Clairborne, Tenn.	0.88	8.7	10.0	14.8	15.9
2236 - Walnut Mountain	Campbell, Tenn.	0.82	17.3	22.0	22.0	22.0
2237 - Swany	Marion, Tenn.	0.66	7.8	11.1	9.1	9.1
2238 - Peabody	Campbell, Tenn.	0.71	10.5	12.8	7.0	5.6
2239 - Laramie No. 3	Weld, Colorado	0.36	3.2	8.8	5.6	0.0
2240 - Bevier	Boone, Missouri	5.34	29.4	36.1	39.0	48.3
2241 - Collom	Moffat, Colorado	0.32	0.0	0.0	3.1	6.2
2242 - Des Moines No. 1	Marion, Iowa	3.81	34.6	39.2	30.7	36.2
2243 - Lower Cherokee	Mahaska, Iowa	6.76	21.6	25.0	32.0	35.7
2244 - Cannon City	Freemont, Colorado	0.51	0.0	9.3	11.8	17.6
2245 - Wadge	Routt, Colorado	0.49	0.0	0.0	0.0	0.0
2256 - Upper and Lower Hartshorne	Haskell, Oklahoma	1.16	1.8	9.6	17.2	43.1
2257 - Sequoyha	Chelsea, Oklahoma	0.56	1.8	5.2	0.0	0.0
2258 - Fort Scott	Chelsea, Oklahoma	6.37	30.7	32.4	39.1	48.5
2259 - Mulkey	Macon, Missouri	4.45	18.0	23.0	26.3	30.3
2260 - Stigler	Haskell, Oklahoma	0.71	11.6	17.1	19.7	19.7
2261 - Tebo	Henry, Missouri	4.93	38.4	44.5	47.5	52.1
2281 - Lower Spadra	Johnson, Arkansas	4.28	25.8	41.6	50.0	69.4
2282 - Upper Spadra	Johnson, Arkansas	1.90	50.0	53.8	55.8	56.8
2283 - Charleston	Franklin, Arkansas	3.67	11.2	15.8	26.4	46.6

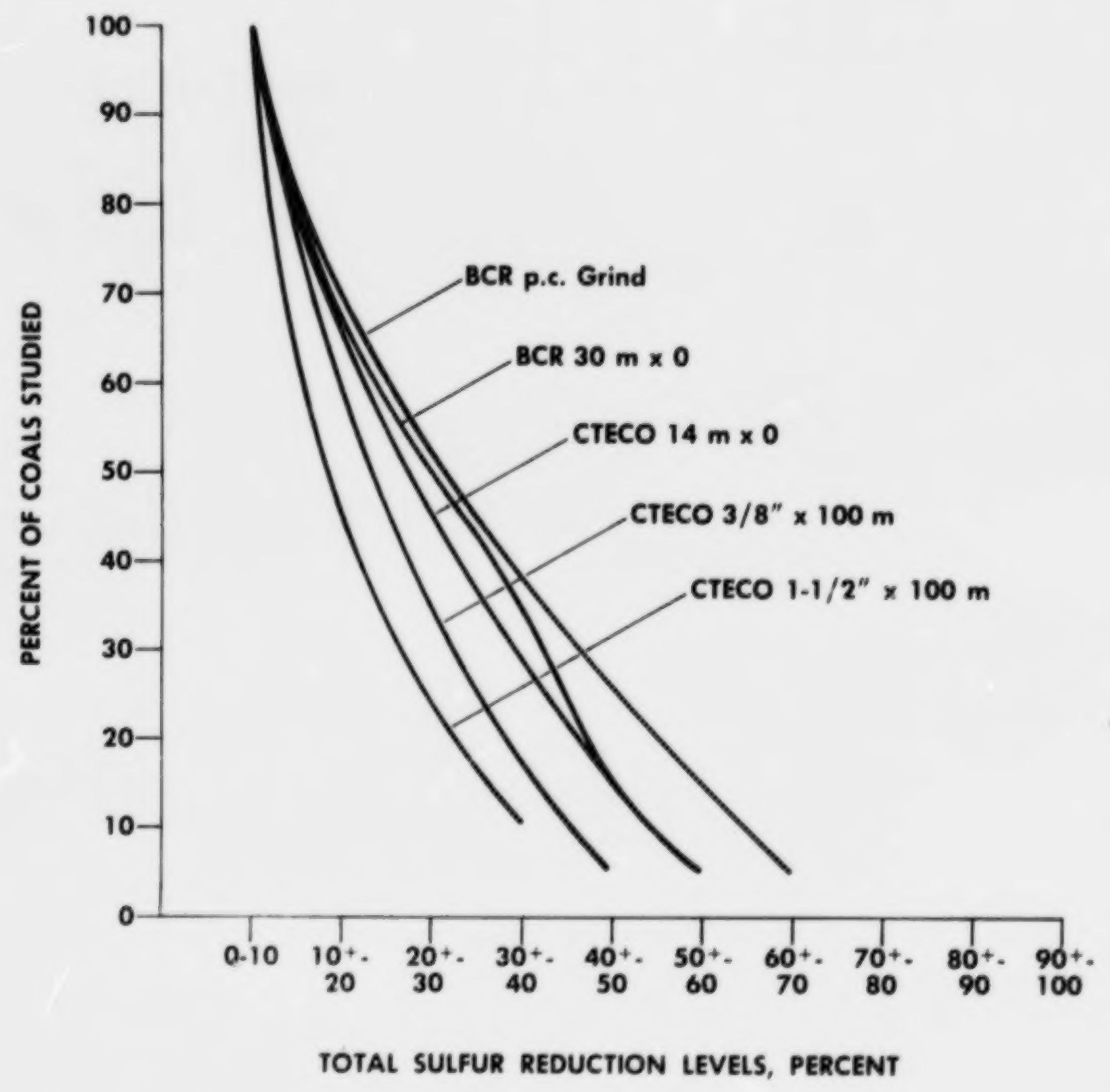

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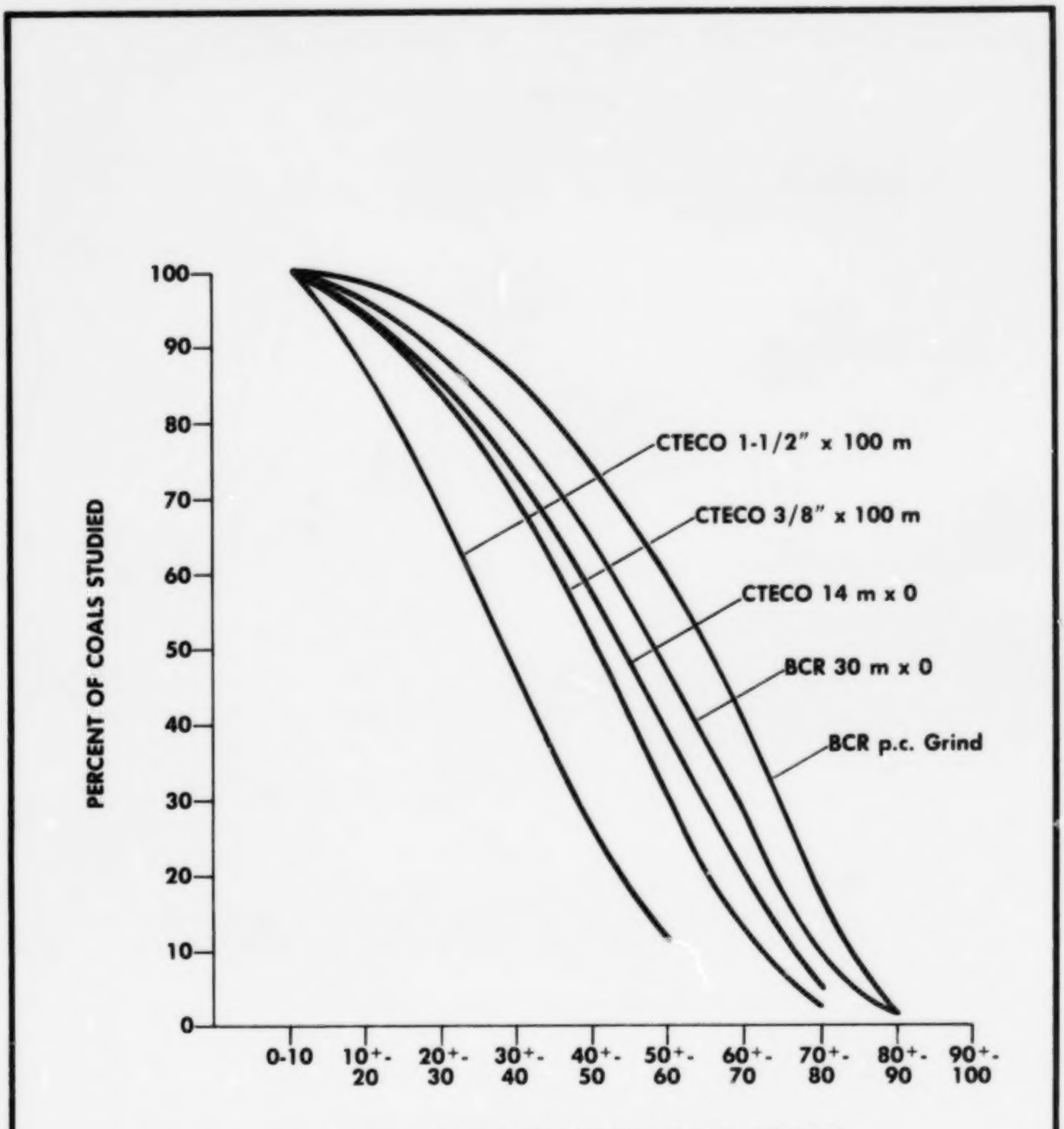
Figure 1. Total Sulfur Reduction at 1.60 Specific Gravity as Related to Nominal Topsize of Coal for 20 Southern, Western and Mid-Western Coals



Bituminous Coal Research, Inc. 6070G43

Figure 2. Total Sulfur Reduction at 1.60 Specific Gravity as Related to Nominal Topsize for 90 United States Coals

between curves. The second greatest reduction is obtained when the coal is reduced from a 30 mesh topsize to the coal's p.c. grind.

Table 3 shows the ash reductions obtainable at four levels of crushing with these coals when they are cleaned at 1.60 specific gravity. High ash reductions at the largest topsize indicate that this ash equivalent occurred as obvious impurities, such as roof material or seam-included rock layers. Gradual ash reductions certainly reflect the reduction of pyritic sulfur as the topsize of the R.O.M. coal is decreased, but these reductions could also reflect the liberation and removal of other impurities ranging from pure shales to high-ash coal particles.

The individual data sheets for the Phase I test work are contained in the appendix to this report, Tables A-1 to A-20.

IV. PHASE II EVALUATIONS

A. Test Procedure - Precleaning

Three coals were selected from the 20 coals studied under Phase I of the program for the Phase II, Coal Cleaning Studies. Each of the three coals was rough-cleaned at the 3/8 inch x 0 size consist on the concentrating table to effect a separation in which the obvious refuse was removed prior to further size reduction. Figure 3 shows the various zones of material obtained from a concentrating table separation and the analyses obtained on the various fractions.

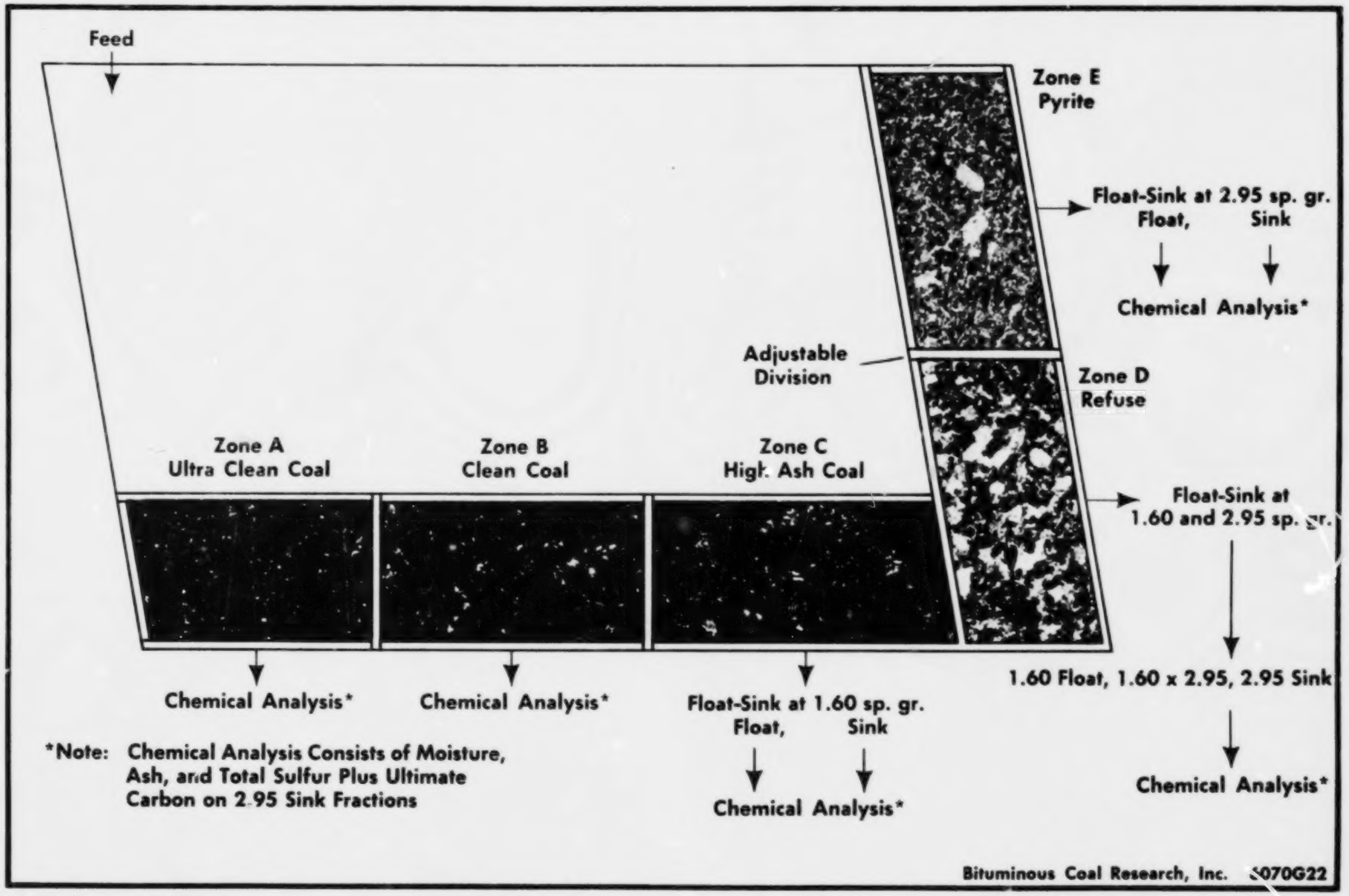
In the 3/8 inch x 0 rough cleaning, the high carbon refuse fraction, which is normally discharged in actual cleaning plant practice because of its high ash content, was combined with the Zone C material for further processing. It is from this high-carbon refuse fraction, together with the high-ash coal normally reporting to Zone C, that significant additional pyrite liberation and removal can be obtained through size reduction and recleaning.

The material obtained from Zones A, B, and C was pulverized to 30 mesh for a second five-zone separation on the concentrating table as shown in Figure 3, and a two-way separation, a clean coal-refuse split in the compound water cyclone.

Table 4 shows the size consist of the feed material for the 3/8 inch x 0 concentrating table tests for the three coals, and Table 5 shows the size consist of the 30 mesh x 0 feed material for the concentrating table tests and the compound water cyclone tests. Figures 4 to 6 show size distribution for the two size fractions discussed for each of the three coals. Table 6 shows the chemical analyses of these three coals tested under Phase II of the program.

TABLE 3. ASH REDUCTION AT 1.60 SPECIFIC GRAVITY AS RELATED TO NOMINAL TOPSIZE OF COAL

Coal Identification Lot - Seam	Location County, State	Ash Weight Percent, Raw R.O.M. Coal	Percent Reduction at 1.60 Float CTECO 3/8" x 100 M	CTECO 14 M x 0	BCR 30 M x 0	BCR p.c. grind
2235 - Jellico	Clairborne, Tenn.	12.6	75.4	68.8	75.1	78.1
2236 - Walnut Mountain	Compbell, Tenn.	11.0	59.3	64.7	72.6	70.5
2237 - Swany	Marion, Tenn.	10.3	26.0	26.2	24.9	31.3
2238 - Peabody	Campbell, Tenn.	4.20	32.7	36.5	36.9	43.1
2239 - Laramie No. 3	Weld, Colorado	6.80	27.9	29.7	35.9	37.9
2240 - Bevier	Boone, Missouri	19.7	62.2	64.9	65.9	64.5
2241 - Collom	Moffat, Colorado	5.40	7.1	14.4	18.5	27.0
2242 - Des Moines No. 1	Marion, Iowa	10.7	34.1	42.2	30.5	38.5
2243 - Lower Cherokee	Mahaska, Iowa	16.0	46.3	51.0	60.6	63.7
2244 - Cannon City	Freemont, Colorado	13.5	44.3	49.9	46.2	51.3
2245 - Wadge	Routt, Colorado	9.86	17.9	25.3	28.6	36.6
2256 - Upper and Lower Hartshorne	Haskell, Oklahoma	18.6	77.8	74.1	76.5	77.7
2257 - Sequoyha	Chelsea, Oklahoma	6.74	33.1	39.4	45.0	48.2
2258 - Fort Scott	Chelsea, Oklahoma	12.4	55.4	58.3	65.4	67.1
2259 - Mulkey	Macon, Missouri	20.0	68.9	68.5	75.6	72.0
2260 - Stigler	Haskell, Oklahoma	4.0	30.4	39.3	44.5	46.5
2261 - Tebo	Henry, Missouri	18.6	41.7	49.6	56.4	60.4
2281 - Lower Spadra	Johnson, Arkansas	9.20	25.0	31.2	36.6	51.0
2282 - Upper Spadra	Johnson, Arkansas	6.89	42.3	47.4	50.4	57.6
2283 - Charleston	Franklin, Arkansas	9.96	35.4	42.0	51.4	64.7


Feed
Zone A
Ultra Clean Coal
Zone B
Clean Coal
Zone C
High Ash Coal
Adjustable
Division
Zone E
Pyrite
Zone D
Refuse
Float-Sink at 2.95 sp. gr.
Float,
Sink
Chemical Analysis*
Float-Sink at
1.60 and 2.95 sp. gr.
1.60 Float, 1.60 x 2.95, 2.95 Sink
Chemical Analysis*
Chemical Analysis*
Chemical Analysis*
Float-Sink at 1.60 sp. gr.
Float,
Sink
Chemical Analysis*

*Note: Chemical Analysis Consists of Moisture, Ash, and Total Sulfur Plus Ultimate Carbon on 2.95 Sink Fractions

Bituminous Coal Research, Inc. 5070G22

Figure 3. Sampling Flow Sheet for Concentrating Table Tests

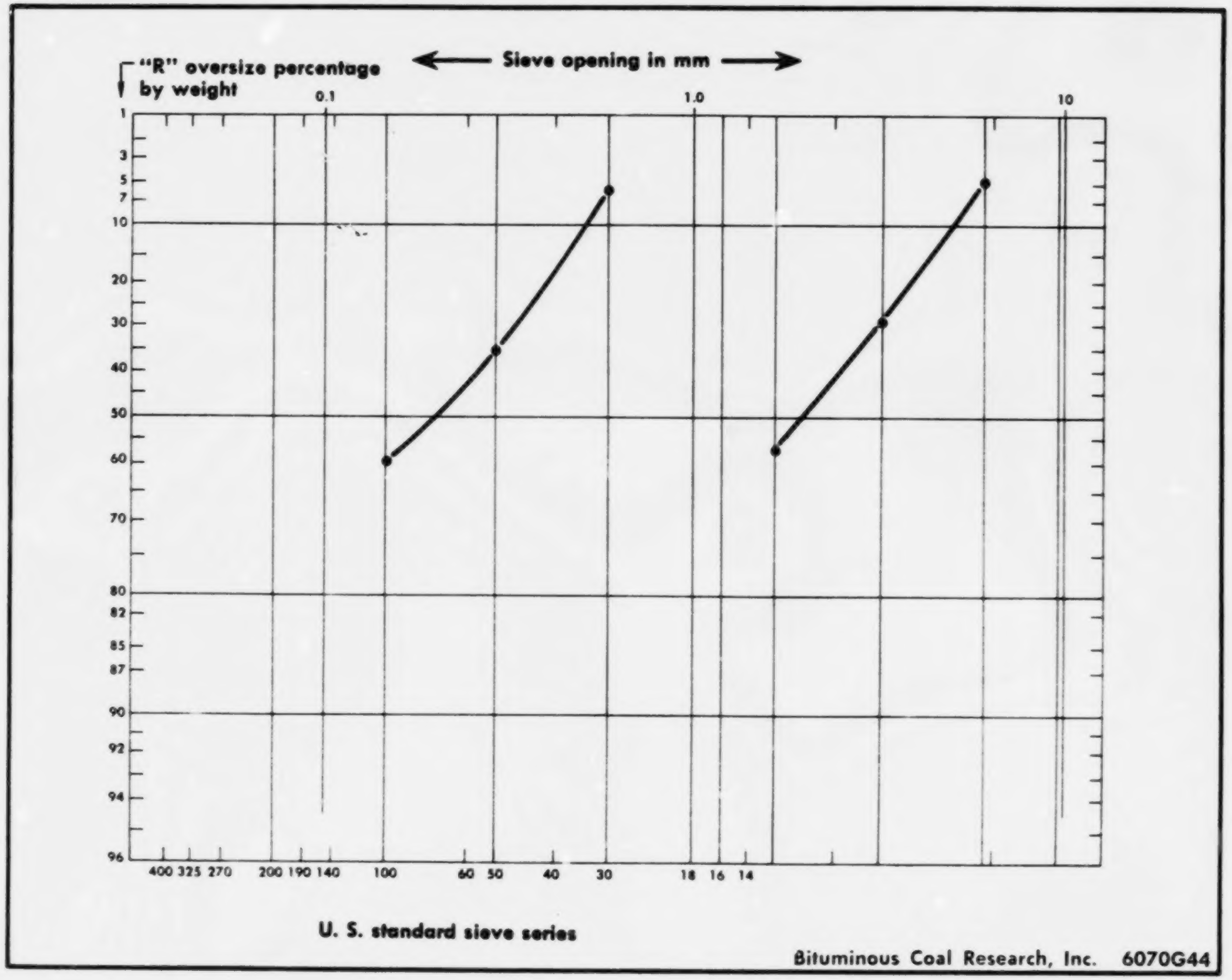
TABLE 4. SCREEN ANALYSES OF R.O.M. 3/8 INCH x 0 FEED TO CONCENTRATING TABLE

Lot No.	2416		2417		2415	
Seam	Upper Spadra		Tebo		Lower Cherokee	
Run No.	1		1		1	
Type of Run	Rough Cleaning		Rough Cleaning		Rough Cleaning	
Screen Size	Weight, Percent	Cumulative Weight, Percent	Weight, Percent	Cumulative Weight, Percent	Weight, Percent	Cumulative Weight, Percent
+ 1/4 Inch	0.6	0.6	5.5	5.5	4.8	4.8
1/4 Inch x 6 Mesh	10.1	10.7	23.7	29.2	24.6	29.4
6 Mesh x 12 Mesh	20.6	31.3	25.0	54.2	26.6	56.0
12 Mesh x 0	68.7	100.0	45.8	100.0	44.0	100.0

TABLE 5. SCREEN ANALYSES OF 30 MESH x 0 FEED TO CONCENTRATING TABLE

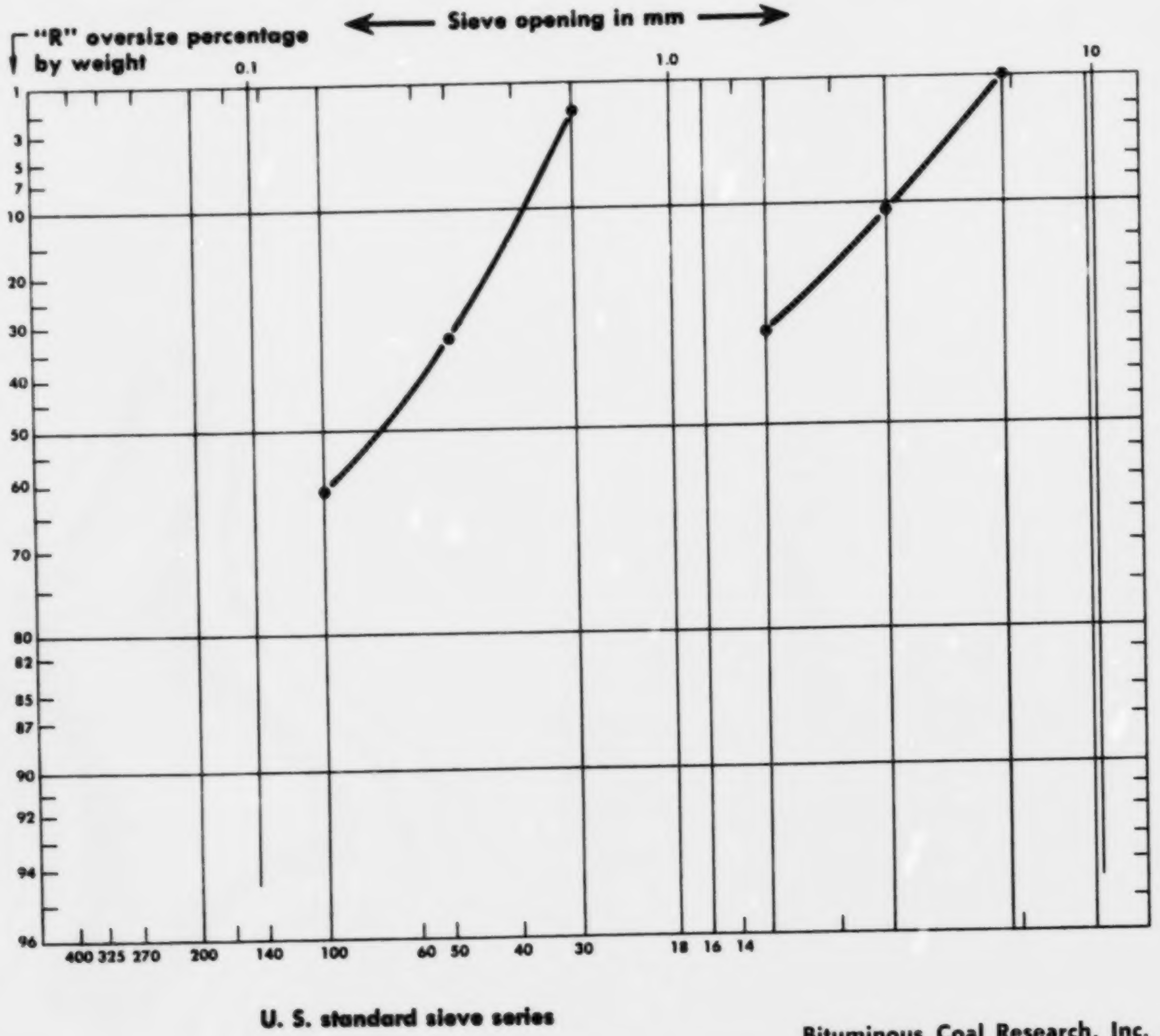
Lot No.	2416	2417	2415
Seam	Upper Spadra	Tebo	Lower Cherokee
Run No.	1	1	1
Type of Run	Precleaned at 3/8 inch x 0	Precleaned at 3/8 inch x 0	Precleaned at 3/8 inch x 0

Screen Size	Weight, Percent	Cumulative Weight, Percent	Weight, Percent	Cumulative Weight, Percent	Weight, Percent	Cumulative Weight, Percent
+ 30 Mesh	1.8	1.8	3.3	3.3	5.7	5.7
30 Mesh x 50 Mesh	29.6	31.4	24.8	28.1	29.5	35.2
50 Mesh x 100 Mesh	29.4	60.8	22.7	50.8	23.4	58.6
100 Mesh x 0	39.2	100.0	49.2	100.0	41.4	100.0



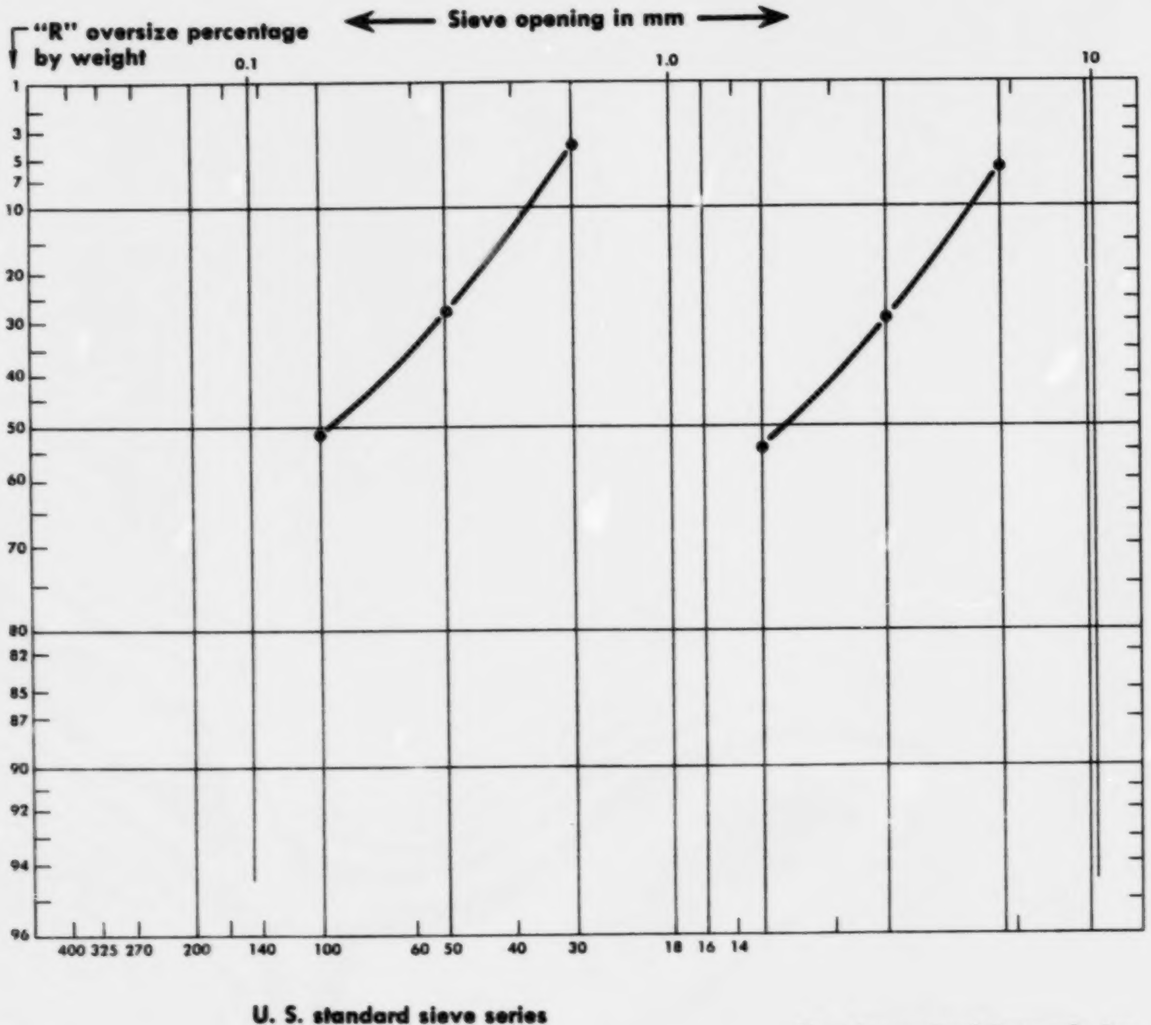
Bituminous Coal Research, Inc. 6070G44

Figure 4. Size Distribution Curves of 30 Mesh x 0 and 3/8 Inch x 0 Concentrating Table Feeds for Lower Cherokee Seam, BCR Sample No. 2415



Bituminous Coal Research, Inc. 6070G45

Figure 5. Size Distribution Curves of 30 Mesh x 0 and 3/8 Inch x 0 Concentrating Table Feeds for Upper Spadra Seam, BCR Sample No. 2416



Bituminous Coal Research, Inc. 6070G46

Figure 6. Size Distribution Curves of 30 Mesh x 0 and 3/8 Inch x 0 Concentrating Table Feeds for Tebo Seam, BCR Sample No. 2417

TABLE 6. ANALYSES OF R.O.M. MIDWESTERN COALS SUBJECTED TO DEEP CLEANING STUDIES, DRY BASIS

Seam Identification	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	C.V. in Btu/lb
Lower Cherokee Seam (BCR Lot No. 2415)	12.8	42.0	45.2	5.12	0.26	4.24	0.62	12,308
Upper Spadra Seam (BCR Lot No. 2416)	6.50	12.5	81.0	1.59	0.08	0.77	0.74	14,429
Tebo Seam (BCR Lot No. 2417)	29.8	34.3	36.0	6.92	0.68	4.44	1.80	9,652

B. Summary of Results

Of the three coals tested, the Tebo seam coal contained the highest percentage of total sulfur and the highest percentages of both pyritic and organic sulfur. All of the values would have been higher had it not been for the fact that the sample was obtained from the edge of the seam and contained an excessive quantity of impurities from the overburden. The nearly 30 percent ash content of this lot of coal shows this.

The most significant reduction in sulfur occurred when the coal was rough cleaned at the 3/8 inch x 0 size and the total sulfur content was reduced from 6.92 percent to 4.57 percent. Pulverizing to 30 mesh and recleaning resulted only in a reduction from 4.57 percent total sulfur to 4.29 percent.

The Lower Cherokee seam coal, with a relatively high total sulfur content (5.12 percent) but with a low organic sulfur content (0.62 percent), behaved in a very similar manner. The most significant reduction again was obtained in the rough cleaning of the 3/8 inch x 0 R.O.M. coal. The total sulfur was reduced from 5.12 percent to 3.53 percent. In the deep cleaning of the 30 mesh x 0 product, the total sulfur was reduced from 3.53 percent to 3.14 percent.

The third coal tested, the Upper Spadra seam, responded the best to deep cleaning, and a 0.97 percent total sulfur clean coal product was obtained by the two-stage process.

Table 6 shows the percent total sulfur reduction obtained for each step of the two-stage cleaning for the three coals on a dry, ash-free basis.

The results obtained when using the compound water cyclone as the second stage, or deep cleaning device, followed the results obtained with the original five coals tested in this manner and reported in the interim report September 1969. It was not possible even with a new type of discharge cone, to make a sharp separation between the coal and pyrite with the compound water cyclone because only the fine, difficult to remove, pyrite remained in the 3/8 inch x 0 precleaned coal. Pulverizing this precleaned coal to 30 mesh obviously did not liberate significant coarse pyrite which could be removed with the compound water cyclone. Additional pyrite was removable when the concentrating table was utilized to clean the 30 mesh material without a significant loss of recovery. Concentrating table recoveries are also shown in Table 7.

Appendix B, Tables B-1 to B-9, contains the results of all Phase II tests with the concentrating table; Appendix C, Tables C-1 to C-13, contains Phase II test results with the compound water cyclone.

TABLE 7. EFFECTS OF TWO-STAGE CONCENTRATING TABLE CLEANING ON TOTAL SULFUR REDUCTION (DRY, ASH-FREE BASIS)

Coal, Sample Identification	Product Weight, Percent	Chemical Analysis, Dry Basis		Dry, Ash-free Total Sulfur	Total Sulfur Reduction Weight Percent
		Ash	Total Sulfur		
2415 Lower Cherokee					
Raw R.O.M. Coal		12.8	5.12	5.87	
Zones A, B, & C Rough Cleaning, 3/8 inch x 0	89.3	9.12	3.53	3.89	33.7
Zones A, B, & C Deep Cleaning, 30 Mesh x 0	95.5	6.48	3.14	3.36	42.8
2416 Upper Spadra					
Raw R.O.M. Coal		6.50	1.59	1.70	
Zones A, B, & C Rough Cleaning, 3/8 inch x 0	96.4	5.24	1.21	1.28	24.7
Zones A, B, & C Deep Cleaning, 30 Mesh x 0	96.5	3.74	0.97	1.01	40.5
2417 Tebo					
Raw R.O.M. Coal		29.8	6.92	9.86	
Zones A, B, & C Rough Cleaning, 3/8 inch x 0	77.6	18.78	4.57	5.63	42.9
Zones A, B, & C Deep Cleaning, 30 Mesh x 0	93.9	11.55	4.29	4.85	50.8

V. PHASE IV EVALUATIONS

A. Introduction

The Phase IV work, Pyrite Beneficiation, was started during the period covered by this report and, therefore, will be described in greater detail than the continuing studies of Phases I and II.

In order to study the concentration of coal-derived pyrite at feed rates that were realistic and relative to the production rate of a rough pyrite concentrate from the coal cleaning process, Bituminous Coal Research, Inc., purchased a smaller concentrating table. The table, designated as a 15S, or metallurgical table, has one-fourth of the area of the quarter deck being used in the coal cleaning studies and one-sixteenth of the area of a commercial coal cleaning deck.

The unit was purchased with two, interchangeable, decks--a riffled deck, and a slime deck. The slime deck has been used in all of the test work to date. In addition, Bituminous Coal Research, Inc., also purchased a hydraulic classifier that could be used to deslime a table feed or produce a series of classified table feeds from a given size consist. The two units, the small concentrating table and the hydraulic classifier, are shown in Figure 7. The following illustration, Figure 8, is a close-up view of the hydraulic classifier.

The metallurgical table with the slime deck is shown in operation and producing a wide band of pyrite concentrate in Figure 9. The sampling mechanism is shown in Figure 10. It should be noted that the small table was set up with five sampling zones, paralleling the sampling set-up for the larger coal cleaning table.

B. Test Procedure

The feed materials for the pyrite beneficiation studies were obtained by taking all the normal Zone E material plus a portion of the material that would have ordinarily gone to adjacent Zone D during a normal 3/8 inch x 0 cleaning run.

As shown in Figure 3, Zone E is a pyrite-rich fraction from the coal cleaning run and Zone D is the remaining refuse. The material diverted from Zone D to Zone E is the highest gravity material normally reporting to Zone D and hence the material most likely to contain additional pyrite that could be liberated by further size reduction. Six coals were processed in this manner, and the ash reductions obtained when cleaning these coals at a 3/8 inch x 0 size are shown in Table 8.

Table 9 shows a typical 3/8 inch x 0 cleaning run in which a deep cut had been made into the normal Zone D so as to insure that all the pyrite had been captured for subsequent recleaning. This so-called deep cut is evidenced by the higher than normal percentage of 2.95 float material in Zone E.

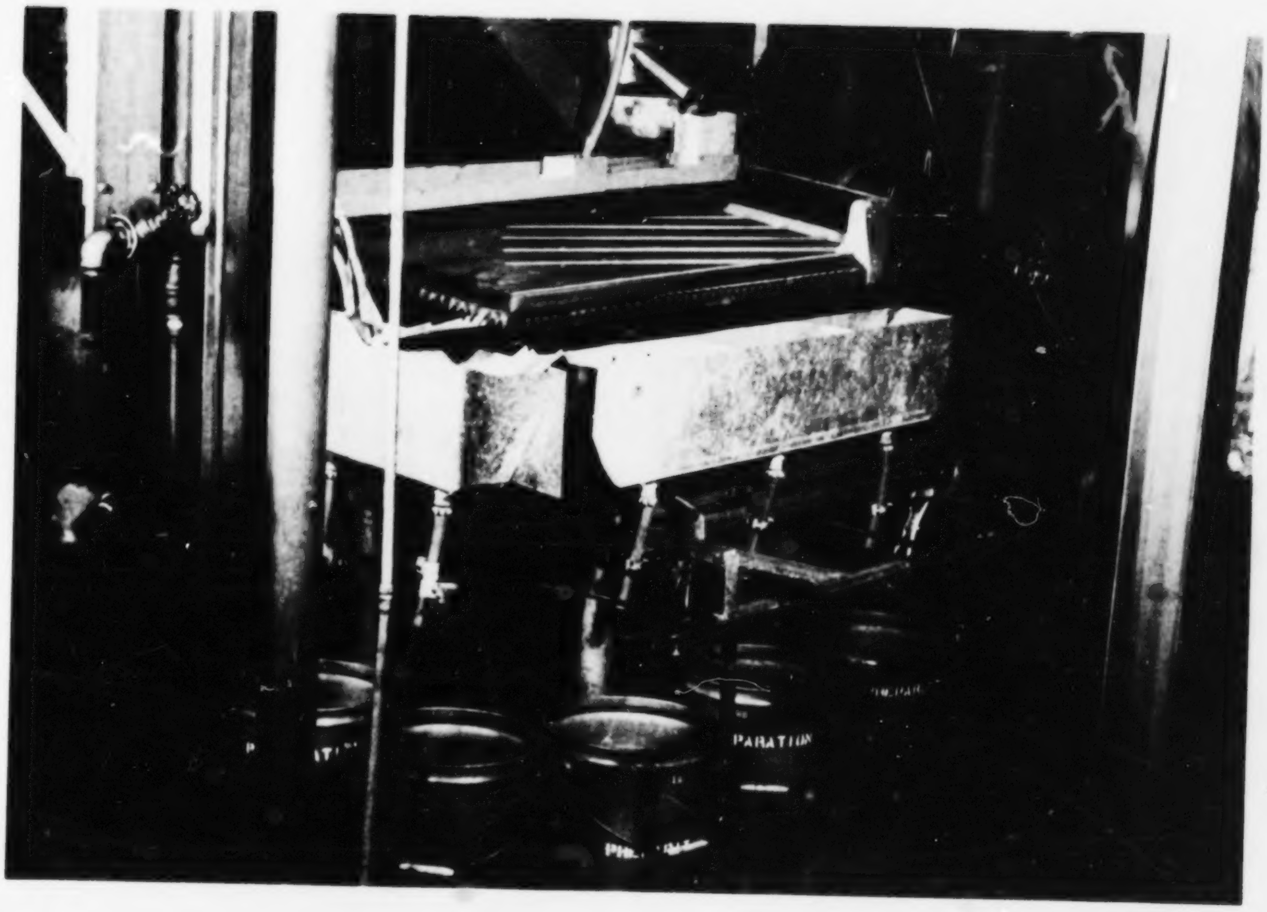


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Figure 7. General View of 15-S Concentrating Table and Hydraulic Classifier

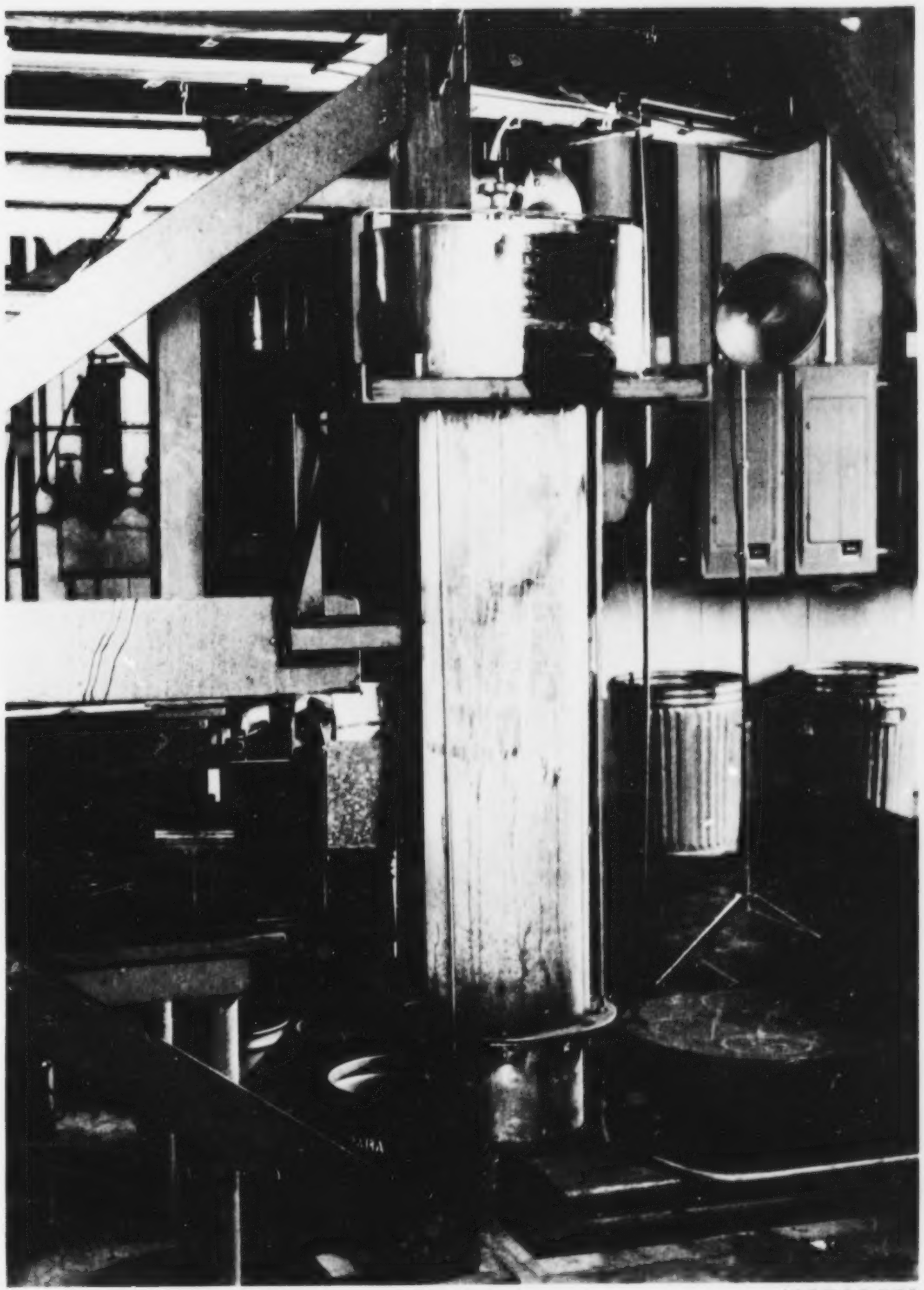

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Figure 8. Hydraulic Classifier Utilized to Deslime Feed Material for 15-S Concentrating Table

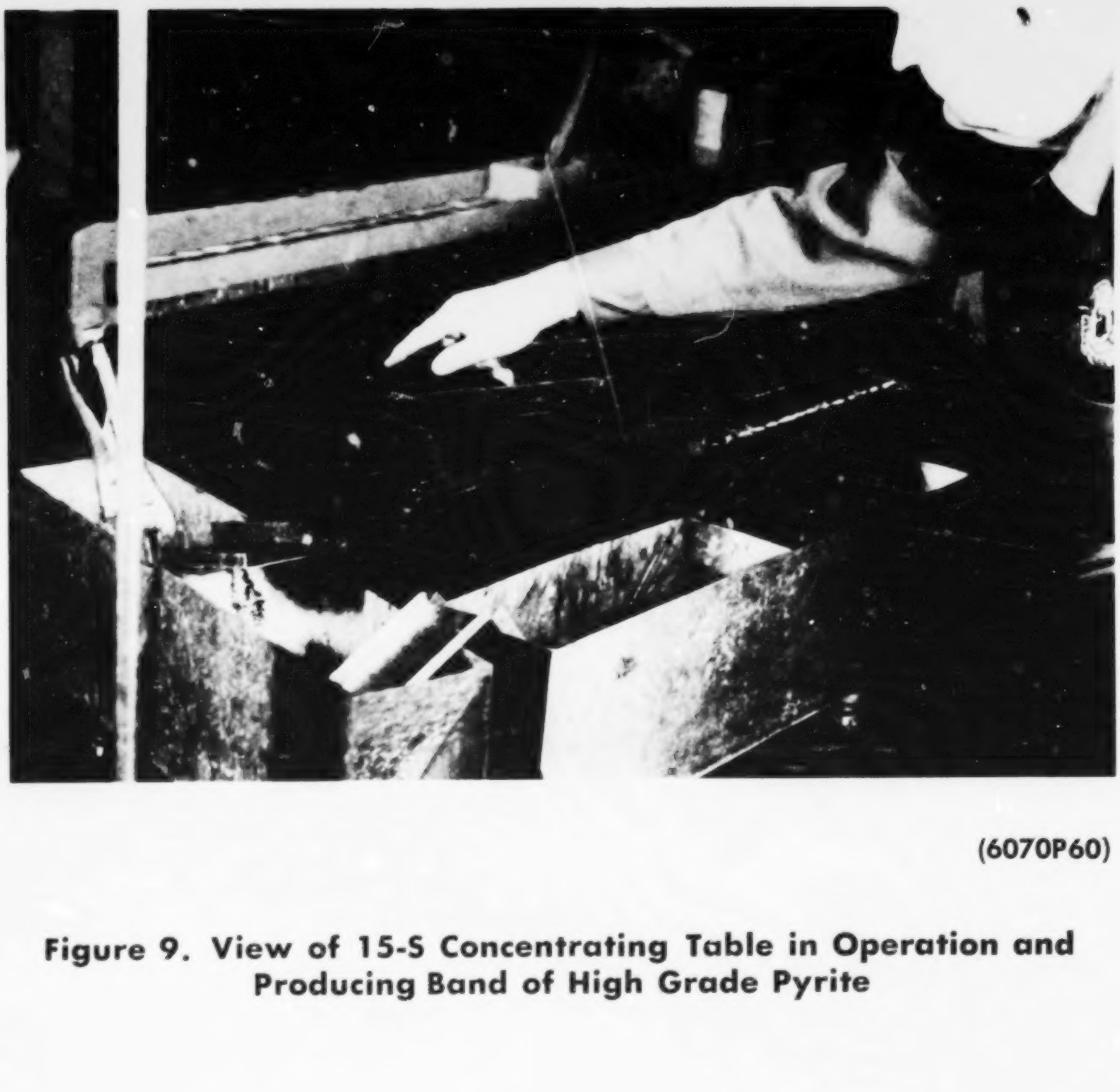

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Figure 9. View of 15-S Concentrating Table in Operation and Producing Band of High Grade Pyrite

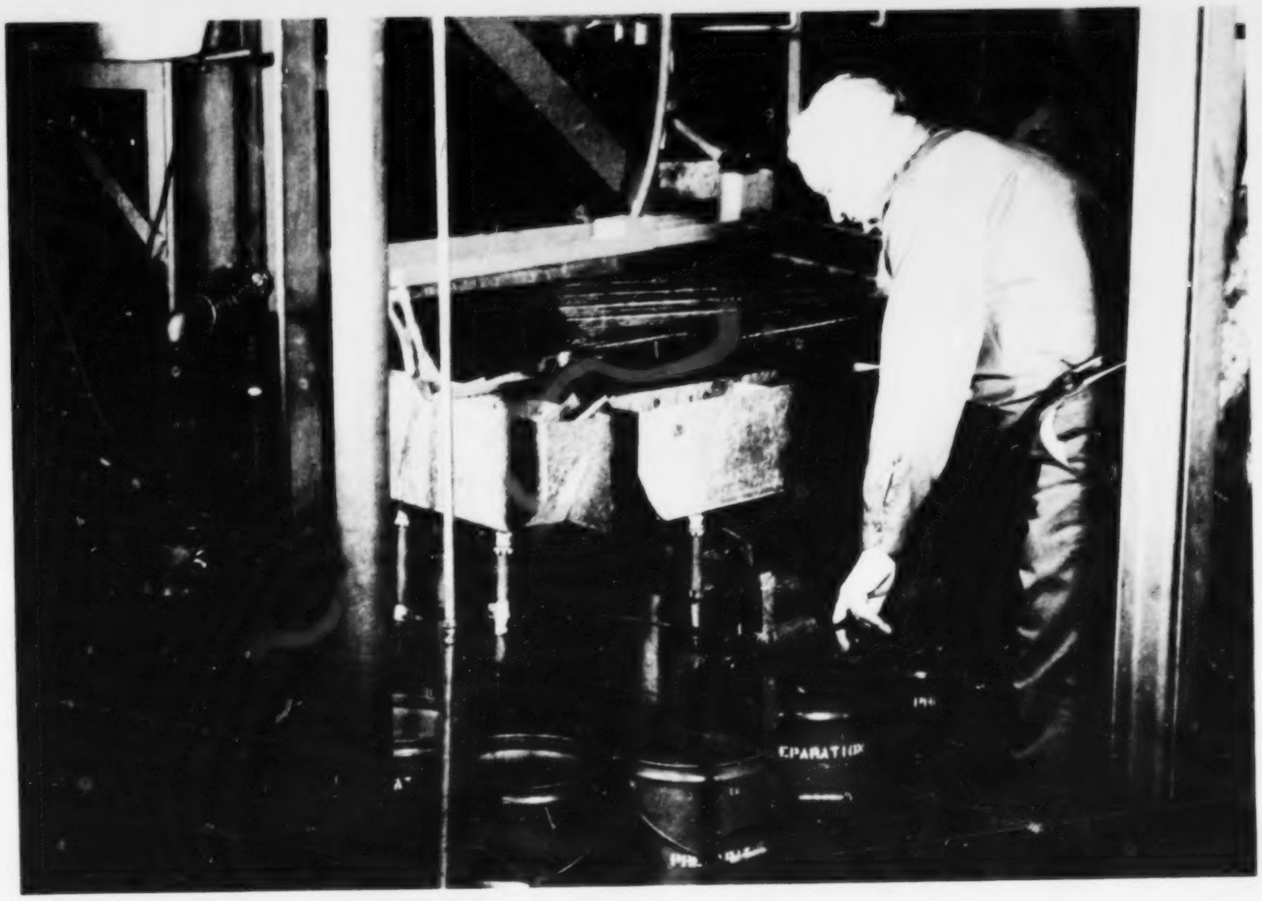

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Figure 10. View of Technician Operating Sampling Device for 15-S Concentrating Table

TABLE 8. ASH REDUCTION OBTAINED BY CONCENTRATING TABLE CLEANING OF 3/8 INCH x 0 R.O.M. COAL

Coal Identification	Ash in R.O.M. Coal, Percent	Clean Coal Weight, Percent	Ash in Clean Coal, Percent	Reduction, Percent
2234 Ohio No. 6	14.8	84.4	6.96	53.0
2255 Upper Kittanning	23.7	71.2	8.49	64.2
2287 Indiana VII	15.1	89.4	11.97	20.7
2299 Lower Freeport	17.6	78.0	6.86	61.0
2415 Lower Cherokee	12.8	89.3	9.12	28.7
2417 Tebo	29.8	77.6	18.78	37.0
Averages	18.97	81.7	10.36	51.5

TABLE 9. SAMPLE COPY OF CONCENTRATING TABLE DATA SHEET FOR 3/8 INCH x 0 COAL CLEANING RUN

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0,
Pyrite Precleaning BCR Sample No. 2234

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	40.2		1.65	6.50	0.76	
Zone B	30.3		0.92	6.90	0.88	
Zone C						
Float at 1.60	13.6	98.0	1.05	7.68	0.98	
Sink at 1.60	0.3	2.0	1.20	45.4	4.42	
Composite	13.9	100.0		8.43	1.05	
Zone D						
Float at 1.60	4.34	71.2	0.99	15.9	1.84	33.5
1.60 by 2.95	1.72	28.2	1.06	44.4	4.60	41.6
Sink at 2.95	0.04	0.6	1.66	63.4	26.6	13.9
Composite	6.1	100.0		24.22	2.77	35.67
Zone E						
Float at 2.95	5.9	62.1	0.44	65.9	7.42	
Sink at 2.95	3.6	37.9	0.37	61.4	42.5	
Composite	9.5	100.0		64.19	20.72	
Composite of Zones A, B, C	84.4			6.96	0.85	
Composite of 1.60 Float Fractions	88.4			7.27	0.89	
Composite of 2.95 Sink Fractions	3.6			61.42	42.33	
Composite of Table Products	100.0			13.45	2.86	
Analysis of Feed to Table			3.08	14.8	3.19	

* Moisture of sample as received in analytical laboratory and the value used to place other analyses on dry basis.

Run Date: 7-1-69

The modified Zone E material from the coal cleaning run was pulverized to 30 mesh in size for the initial pyrite beneficiation test with the metallurgical table utilizing the slime deck. Table 10 shows a sample copy of the information obtained on the 30 mesh x 0 pyrite cleaning run. The pyrite concentrate from Zone E in this 30 mesh x 0 run, which was very high in total sulfur and low in carbon, was not further processed. The Zone D material from this run was collected, pulverized to minus 60 mesh to further liberate high grade pyrite, and recleaned in one of two somewhat similar ways.

The first method of cleaning utilized the hydraulic classifier to deslime the 60 mesh x 0 material prior to recleaning the material on the metallurgical table with the slime deck. Table 11 is a sample copy of the data sheet utilized to show the results obtained during the desliming operation. A relatively high percentage of fine pyrite was lost during the desliming operation and, therefore, the classifier was not utilized in all of the pyrite beneficiation tests.

Table 12 is a sample copy of the data sheet utilized to show the separation obtained on the metallurgical table when using 60 mesh x 0 classifier-deslimed feed material. The material breakdown by zones is shown with the secondary pyrite concentrate being obtained from Zone E.

Table 13 is a tabulation of the pyrite cleaning steps, showing, in the last line of figures, that 1.6 percent of the total coal feed is recoverable as high grade pyrite containing 48.30 percent sulfur.

The sample flowsheet, Table 14, shows the steps of pyrite cleaning in a different manner, utilizing a schematic flow diagram and showing the distribution of total sulfur in pounds per ton of R.O.M. coal.

The final sample copy of a data sheet (Table 15) shows the chemical data by steps and the total quantity of material removed from each step for subsequent reprocessing.

Data sheets similar to Tables 12 to 15 were also utilized in the tests in which the hydraulic classifier was eliminated.

C. Summary of Results

Table 16 shows the results obtained with the six coals tested in preparing a high grade pyrite concentrate. Column 1 shows the total amount of sulfur available in the R.O.M. coal for removal and column 2 shows the percent of pyritic sulfur.

Columns 3 and 4 show the percent of sulfur recovered in the pyrite concentrate; the first for total sulfur and the second for pyritic sulfur. Using the Ohio No. 6 coal as an example, the data show that 22.9 percent of the total sulfur available in the R.O.M. coal ended up in the pyrite concentrate, and this represented 28.5 percent of the pyritic sulfur in

TABLE 10. SAMPLE COPY OF 15-S CONCENTRATING TABLE DATA SHEET FOR 30 MESH x 0 PYRITE CLEANING RUN

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Zone E, 3/8 Inch x 0 Run (7-1-69) Crushed to 30 Mesh x 0

BCR Sample No. 2234

		Chemical Analysis, Dry Basis, Weight Percent			
Table Products	Product, Weight Percent	Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	52.9	0.96	52.2	6.23	
Zone B	3.2	0.72	71.6	6.72	
Zone C	0.5	0.99	69.6	14.10	
Zone D	29.2	0.25	72.4	25.40	6.9
Zone E	14.2	0.10	64.4	48.60	3.9
Composite of Table Products	100.0		60.54	17.93	
Analysis of Feed to Table		0.41	64.19	20.72	

*** Moisture of sample as received in analytical laboratory and the value used to place other analyses on dry basis.**

Run Date: 7-28-69

TABLE 11. SAMPLE COPY OF HYDRAULIC CLASSIFIER TEST DATA SHEET

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Hydraulic Classifier Tests - Pyrite Beneficiation

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Zone D, 30 Mesh x 0 Run (7-28-69) Crushed to 60 Mesh x 0

BCR Sample No. 2234

Classifier Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent		
		Moisture	Ash	Total Sulfur
Overflow Slimes	34.7	0.56	72.8	19.2
Deslimed Product	65.3	0.30	71.8	26.4
Composite of Classifier Products	100.0		72.15	23.9
Analysis of Feed to Classifier		1.50	72.4	25.4

Run Date: 8-5-69

* Moisture of sample as received in analytical laboratory and the value used to place other analyses on dry basis.

TABLE 12. SAMPLE COPY OF 15-S CONCENTRATING TABLE DATA SHEET FOR CLASSIFIER DESLIMED 60 MESH x 0 PYRITE CLEANING RUN

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Zone D, 30 Mesh x 0 Run (7-28-69) Crushed to 60 Mesh x 0, Classifier Deslimed
Product (8-5-69)

BCR Sample No. 2234

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent: Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	8.5	0.51	72.6	15.0	
Zone B	1.5	0.78	72.6	14.6	
Zone C	6.7	0.34	73.4	14.8	
Zone D	66.4	0.39	73.1	24.2	6.4
Zone E	16.9	0.10	66.2	46.8	2.2
Composite of Table Products	100.0		71.9	26.5	
Analysis of Feed to Table		0.30	71.8	26.4	

*** Moisture of sample as received in analytical laboratory and the value used to place other analyses on dry basis.**

Run Date: 8-21-69

BCR Form 172

TABLE 13. SAMPLE COPY OF DATA SHEET SHOWING STEPWISE RECOVERY OF PYRITE

Pyrite Beneficiation - Effects of Two-stage Cleaning

Coal Identification OHIO NO. 6, COLUMBIANA COUNTY, OHIO

BCR Sample No. 2234

Pyrite Precleaning

Concentrating Table No. 14 Test Run Date 7-1-69

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	14.80	3.19
Zone E (Pyrite Zone)	9.5	64.19	20.72

Pyrite Cleaning

Concentrating Table No. 15-S Test Run Date 7-28-69

Feed to Concentrating Table: Zone E, 3/8 Inch x 0 Run (7-1-69) Crushed to 30 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	64.19	20.72
Zone E (Pyrite Zone)	14.2	64.40	48.60

Concentrating Table No. 15-S Test Run Date 8-21-69

Feed to Concentrating Table: Zone D, 30 Mesh x 0 Run (7-28-69) Crushed to 60 Mesh x 0, Classifier Product

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	71.80	26.40
Zone E (Pyrite Zone)	16.9	66.20	46.80

Two Stage Pyrite Product	1.6	64.70	48.30

TABLE 14. SAMPLE FLOWSHEET

Flowsheet for Pyrite Beneficiation Tests, Phase IV
Hydraulic Classifier in System

Ohio No. 6 Seam, Columbiana County, Ohio BCR Sample No. 2234

Pounds of Total Sulfur/Ton of Run-of-Mine Coal

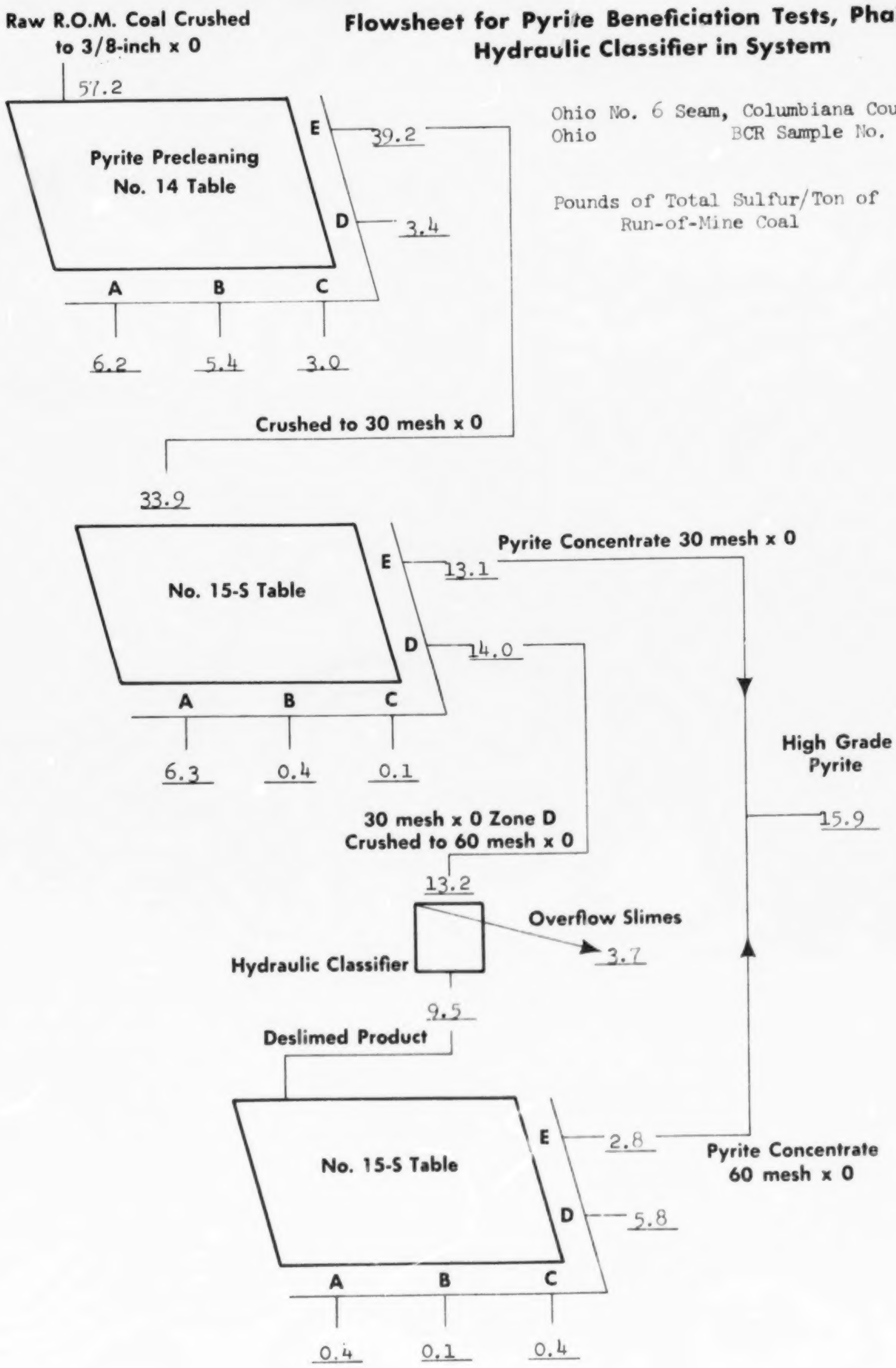
Raw R.O.M. Coal Crushed to 3/8-inch x 0
57.2
Pyrite Precleaning No. 14 Table
E
39.2
D
3.4
A
B
C
6.2
5.4
3.0
Crushed to 30 mesh x 0
33.9
No. 15-S Table
E
13.1
Pyrite Concentrate 30 mesh x 0
D
14.0
A
B
C
6.3
0.4
0.1
High Grade Pyrite
15.9
30 mesh x 0 Zone D
Crushed to 60 mesh x 0
13.2
Overflow Slimes
3.7
Hydraulic Classifier
9.5
Deslimed Product
No. 15-S Table
E
2.8
Pyrite Concentrate 60 mesh x 0
D
5.8
A
B
C
0.4
0.1
0.4

Table 15. Sample Copy of Data Sheet Showing Complete Summary of Chemical Analyses by Steps

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Flowsheet Data for Pyrite Beneficiation Tests, Phase IV

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

BCR Sample No. 2234

Fraction	Weight Percent		Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
3/8 Inch x 0 R.O.M. Coal Processed on Model No. 14 Concentrating Table				
Zone A	40.2		6.50	0.76
Zone B	30.3		6.90	0.88
Zone C	13.9		8.43	1.05
Zone D	6.1		24.22	2.77
Zone E		9.5*	64.19	20.72
3/8 Inch x 0, Zone E, Material, Pulverized to Minus 30 Mesh and Processed on 15S Metallurgical Table				
Zone A	5.0		52.2	6.28
Zone B	0.3		71.6	6.72
Zone C	0.1		69.6	14.10
Zone D		2.8*	72.4	25.40
Zone E	1.3		64.4	48.60
30 Mesh x 0 Zone E Material Deslimed in Hydraulic Classifier				
Overflow Slimes	1.0		72.8	19.2
Deslimed Product		1.8*	71.8	26.4
30 Mesh x 0 Deslimed Product Pulverized to Minus 60 Mesh and Processed on 15S Metallurgical Table				
Zone A	0.2		72.6	15.0
Zone B	0.03		72.6	14.6
Zone C	0.1		73.4	14.8
Zone D	1.2		73.1	24.2
Zone E	0.3		66.2	46.8
Composite of Fractions	100.0		12.40	2.54
Analysis of Feed Coal			14.8	3.19

* Portion of total sample removed for subsequent processing.

Table 16. Sulfur Recovery in Pyrite Concentration Tests

Coal Identification		Total Sulfur, R.O.M. Coal, Percent	Pyritic Sulfur, R.O.M. Coal, Percent	Sulfur Reclaimed in Pyrite Concentrate, Percent		Total Sulfur, Pyrite Concentrate, Percent
				Total Sulfur	Pyritic Sulfur	
2234	Ohio No. 6	3.19	2.56*	22.9	28.5	48.59
2255	Upper Kittanning	2.02	1.72*	46.0	54.1	35.64
2287	Indiana VII	1.06	0.39	3.8	10.3	44.07
2299	Lower Freeport	2.82	2.07	18.1	24.6	45.96
2415	Lower Cherokee	5.12	4.24	13.1	15.8	44.70
2417	Tebo	6.92	4.44	12.3	19.1	47.18
Averages		3.52	2.57	19.4	25.4	44.36

* Based on Phase I Evaluation Analysis

the R.O.M. coal. The last column shows the percent sulfur in the high grade pyrite.

The ultimate carbon in these high grade pyrite concentrates is rather low, as shown in Table 17. Low ultimate carbon is desirable for the normal processes that convert high grade pyrite to sulfuric acid or elemental sulfur.

Many other combinations of high carbon, high sulfur, and relatively high ash material exist for new or conceptual processes combining sulfur recovery and maximum utilization of Btu. The test program was tailored to this approach so that any combination of products could be evaluated. Potential fractions can be found in Zones C and D of the original coal cleaning test as shown in Tables 9, 14, and 15; from the original 30 mesh x 0 pyrite concentration in Zones A, B, or C as shown in Tables 10, 14, and 15; and, finally, in the 60 mesh x 0 pyrite concentration primarily in Zone D as shown in Tables 12, 14, and 15.

The best overview of the results obtained with the six coals tested under Phase IV, Pyrite Beneficiation, can be found in the data sheet of which Table 15 is a sample. Table 15 presents the data obtained when the hydraulic classifier was utilized to prepare feed for the last test in the series with a given coal at the 60 mesh x 0 size. Table 15 shows that the R.O.M. coal, when the hydraulic classifier is used, is broken down into 14 distinct fractions. The distribution of these 14 fractions on a weight basis is shown in the left hand column under weight percent. The offset (right hand column) values under weight percent show the quantity of material removed from that particular processing step for reprocessing.

In the evaluation of these data it can be seen that three of the fourteen fractions produced clearly fall into the category of fuel for a low sulfur combustor. These fractions are Zones A, B, and C of the 3/8 inch x 0 R.O.M. coal cleaning run. These three zones represent 84.4 percent of the total R.O.M. coal and have a composite ash value of 6.96 percent and a total sulfur value of 0.85 percent. These data are shown in composite form in Table 9. Table 9 also shows that, in this particular run, an additional 4 percent of the material could have been directed to the clean coal, with proper table settings, giving a total yield of coal of 88.4 percent, having an ash content of 7.27 percent and a total sulfur content of 0.89 percent.

It should be pointed out that Table 9 gives additional data on Zones C and D so that they can be replaced with five distinct fractions, giving a grand total of 17 fractions.

Returning to Table 15, two fractions are definite feedstock material for a contact acid plant: Zone E material from the 30 mesh x 0 pyrite concentrating run and Zone E material from the portion of the refuse pulverized to 60 mesh. This material represents 1.6 percent of the total feed and has a composite ash content of 64.7 percent and sulfur content

TABLE 17. TOTAL SULFUR AND ULTIMATE CARBON CONTENTS OF HIGH GRADE PYRITE CONCENTRATES PREPARED FROM SIX R.O.M. COALS

Coal Information		Sulfur, Percent	Ultimate Carbon, Percent
Sample No.	Seam		
2234	Ohio No. 6	48.59	3.63
2255	Upper Kittanning	35.64	4.84
2287	Indiana VII	44.07	2.93
2299	Lower Freeport	45.96	4.45
2415	Lower Cherokee	44.70	5.46
2417	Tebo	47.18	3.51

of 48.3 percent. This composite information is shown in the bottom line of Table 13.

Of the fourteen fractions shown in Table 15, five have been easily directed to end uses. In this particular evaluation, and this is not always the case, the Zone D material from the processing of the 3/8 inch x 0 R.O.M. coal, representing 6.1 percent of the total product and having an ash content of 24.22 percent and a sulfur content of 2.77 percent, would be directed to the high-ash, high-sulfur combustor. The remaining eight fractions have to be directed to either this high-ash, high-sulfur combustor or to refuse. Since all of the remaining fractions have ash contents of near 70 percent, or higher, the distribution of this remaining material would have to be made on the basis of recovering additional sulfur values. Until more is known on the design and feedstock criteria for the high-ash, high-sulfur combustor, projecting the distribution of this material to its end use or disposal would be risky. The data are available for future evaluation. Each coal is a study in its own right as there is no stereotype.

The complete data for each of the six coals are contained in Appendix D, Tables D-1 to D-45.

Appendix A

PHASE I EVALUATIONS--FLOAT-SINK TESTS

Moisture as reported on all Tables is the moisture of the sample as received in the analytical laboratory. This value is used to place other analyses on a dry basis.

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TABLE A-1

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification JELLICO SEAM, CLAIRBORNE COUNTY, TENNESSEE
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2235

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.34	12.6	34.8	52.6	0.88	0.06	0.39	0.43	13,006

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	84.9	3.14	0.75	0.18	--	14.8
Sink at 1.60	15.1	66.6	1.50	--		
Composite	100.0	12.72	0.86	--		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	87.8	2.76	0.74	--	--	15.9
Sink at 1.60	12.2	71.1	1.82	--		
Composite	100.0	11.10	0.87	--		

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TABLE A-2

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification WALNUT MOUNTAIN SEAM, CAMPBELL COUNTY, TENNESSE
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2236

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.36	11.0	37.6	51.4	0.82	--	0.42	0.40	13,118

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	87.7	3.01	0.64	0.08	--	22.0
Sink at 1.60	12.3	62.3	1.86	--		
Composite	100.0	10.30	0.79	--		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	88.5	3.25	0.64	--	--	22.0
Sink at 1.60	11.5	66.0	2.24	--		
Composite	100.0	10.47	0.82	--		

TABLE A-3

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification SWANY SEAM, MARION COUNTY, TENNESSEE
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2237

Chemical Analysis, As Received:

				Weight %, Dry Basis				
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.94	10.3	29.2	60.5	0.66	--	0.25	0.41	13,548

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	93.3	7.74	0.60	0.14	--	9.1
Sink at 1.60	6.7	51.4	1.70	--		
Composite	100.0	10.67	0.67	--		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	93.6	7.08	0.60	--	--	9.1
Sink at 1.60	6.4	53.8	1.92	--		
Composite	100.0	10.07	0.68	--		

TABLE A-4

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification PEABODY SEAM, CAMPBELL COUNTY, TENNESSEE
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2238

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.60	4.20	38.1	57.7	0.71	--	0.15	0.56	14,194

Analyses of As-received Sample Reduced to Minus 30 Mesh:

	Float and Sink, Weight, %	Chemical Analysis, Dry Basis			Weight, % Reduction	
		Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	96.6	2.65	0.66	0.07	--	7.0
Sink at 1.60	3.4	48.7	2.88	--		
Composite	100.0	4.22	0.74	--		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

	Float and Sink, Weight, %	Chemical Analysis, Dry Basis			Weight, % Reduction	
		Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	96.7	2.39	0.67	--	--	5.6
Sink at 1.60	3.3	52.4	3.14	--		
Composite	100.0	4.04	0.75	--		

TABLE A-5

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LARAMIE NO. 3 SEAM, WELD COUNTY, COLORADO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2239

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
6.50	6.80	40.4	52.8	0.36	--	0.08	0.28	12,392

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	96.6	4.36	0.34	0.00	--	5.6
Sink at 1.60	3.4	57.6	1.58	--		
Composite	100.0	6.17	0.38	--		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	96.7	4.22	0.36	--	--	0.0
Sink at 1.60	3.3	56.3	1.21	--		
Composite	100.0	5.94	0.39	--		

TABLE A-6

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification BEVIER SEAM, BOONE COUNTY, MISSOURI
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2240

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.43	19.7	37.5	42.8	5.34	0.06	3.49	1.79	11,530

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	75.7	6.72	3.26	1.44	58.7	39.0
Sink at 1.60	24.3	63.4	12.4	11.5		
Composite	100.0	20.49	5.48	3.88		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	80.2	7.00	2.76	0.80	77.1	48.3
Sink at 1.60	19.8	65.4	14.2	13.5		
Composite	100.0	18.56	5.03	3.31		

TABLE A-7

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification COLLOM SEAM, MOFFAT COUNTY, COLORADO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2241

Chemical Analysis, As Received:

		Weight %, Dry Basis						
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
3.89	5.40	43.2	51.4	0.32	--	0.09	0.23	12,952

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	98.0	4.40	0.31	0.06	--	3.1
Sink at 1.60	2.0	36.6	0.44	--		
Composite	100.0	5.04	0.31	--		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	96.3	3.94	0.30	--	--	6.2
Sink at 1.60	3.7	38.4	0.36	--		
Composite	100.0	5.22	0.30	--		

TABLE A-8

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification DES MOINES NO. 1 SEAM, MARION COUNTY, IOWA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2242

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
2.62	10.7	43.2	46.1	3.81	0.07	2.62	1.12	12,484

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	93.8	7.44	2.64	1.48	43.5	30.7
Sink at 1.60	6.2	54.8	18.3	18.1		
Composite	100.0	10.38	3.61	2.51		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	92.5	6.58	2.43	1.29	50.8	36.2
Sink at 1.60	7.5	51.8	17.6	17.6		
Composite	100.0	9.97	3.57	2.51		

TABLE A-9

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LOWER CHEROKEE SEAM, MAHASKA COUNTY, IOWA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2243

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.84	16.0	44.2	39.8	6.76	0.19	3.49	3.08	11,550

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	81.2	6.30	4.60	1.22	66.0	32.0
Sink at 1.60	18.8	54.4	13.8	13.7		
Composite	100.0	15.34	6.33	3.57		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	81.5	5.80	4.35	0.77	77.9	35.7
Sink at 1.60	18.5	58.0	15.7	14.9		
Composite	100.0	15.46	6.45	3.38		

TABLE A-10

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification CANNON CITY SEAM, FREEMONT COUNTY, COLORADO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2244

Chemical Analysis, As Received:

				Weight %, Dry Basis				
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
5.44	13.5	38.8	47.7	0.51	--	0.25	0.26	11,630

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	89.7	7.26	0.45	--	--	11.8
Sink at 1.60	10.3	64.6	0.95	--		
Composite	100.0	13.17	0.50	--		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	88.3	6.58	0.42	--	--	17.6
Sink at 1.60	11.7	56.7	1.12	--		
Composite	100.0	12.44	0.50	--		

TABLE A-11

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification WADGE SEAM, ROUTT COUNTY, COLORADO
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2245

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
5.92	9.86	39.8	50.3	0.49	0.02	0.09	0.38	11,922

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	94.9	7.04	0.50	--	--	0.0
Sink at 1.60	5.1	51.8	0.84	--		
Composite	100.0	9.32	0.52	--		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	93.7	6.25	0.52	--	--	0.0
Sink at 1.60	6.3	51.4	0.82	--		
Composite	100.0	9.09	0.54	--		

TABLE A-12

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification UPPER AND LOWER HARTSHORNE SEAM, HASKELL COUNTY, OKLAHOMA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2256

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.52	18.6	21.4	60.0	1.16	0.03	0.95	0.18	12,400

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	75.5	4.38	0.96	0.50	47.4	17.2
Sink at 1.60	24.5	69.4	1.78	1.78		
Composite	100.0	20.31	1.16	0.81		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	77.9	4.14	0.66	0.16	83.2	43.1
Sink at 1.60	22.1	70.0	2.90	2.80		
Composite	100.0	18.70	1.16	0.74		

TABLE A-13

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification SEQUOYHA SEAM, CHELSEA COUNTY, OKLAHOMA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2257

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.72	6.74	34.0	59.3	0.56	0.01	0.20	0.35	13,722

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	95.1	3.71	0.70	--	--	0.0
Sink at 1.60	4.9	51.9	1.10	--		
Composite	100.0	6.07	0.72	--		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	93.8	3.49	0.58	--	--	0.0
Sink at 1.60	6.2	48.0	1.20	--		
Composite	100.0	6.25	0.62	--		

TABLE A-14

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification FORT SCOTT SEAM, CHELSEA COUNTY, OKLAHOMA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2258

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.19	12.4	39.7	47.9	6.37	0.16	4.66	1.55	12,904

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	87.9	4.29	3.88	2.18	53.2	39.1
Sink at 1.60	12.1	63.8	21.8	21.8		
Composite	100.0	11.49	6.05	4.55		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	85.4	4.08	3.28	1.41	69.7	48.5
Sink at 1.60	14.6	59.2	23.2	22.3		
Composite	100.0	12.13	6.19	4.46		

TABLE A-15

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification MULKEY SEAM, MACON COUNTY, MISSOURI
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2259

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.91	20.0	39.0	41.0	4.45	0.14	2.04	2.27	11,127

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.2	4.88	3.28	0.53	74.0	26.3
Sink at 1.60	20.8	72.2	7.83	7.51		
Composite	100.0	18.88	4.23	1.98		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.4	5.60	3.10	0.28	86.3	30.3
Sink at 1.60	20.6	69.6	8.98	7.43		
Composite	100.0	18.78	4.31	1.75		

TABLE A-16

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification STIGLER SEAM, HASKELL COUNTY, OKLAHOMA
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2260

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.52	4.00	27.0	69.0	0.71	0.02	0.28	0.41	14,929

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	95.5	2.22	0.57	--	--	19.7
Sink at 1.60	4.5	41.9	3.27	--		
Composite	100.0	4.01	0.69	--		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	93.5	2.14	0.57	--	--	19.7
Sink at 1.60	6.5	39.8	3.11	--		
Composite	100.0	4.59	0.74	--		

TABLE A-17

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2261

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
1.30	18.6	38.6	42.8	4.93	0.18	3.06	1.69	11,664

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	83.9	8.11	2.59	0.71	76.8	47.5
Sink at 1.60	16.1	59.4	14.2	13.5		
Composite	100.0	16.37	4.46	2.77		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	79.7	7.36	2.36	0.39	87.3	52.1
Sink at 1.60	20.3	57.4	14.2	12.3		
Composite	100.0	17.52	4.76	2.81		

TABLE A-18

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification LOWER SPADRA SEAM, JOHNSON COUNTY, ARKANSAS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2281

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.94	9.20	12.4	78.4	4.28	0.26	3.31	0.71	13,864

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	90.9	5.83	2.14	1.18	64.4	50.0
Sink at 1.60	9.1	40.4	23.6	21.8		
Composite	100.0	8.98	4.09	3.06		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	89.3	4.51	1.31	0.48	85.5	69.4
Sink at 1.60	10.7	44.3	26.4	24.0		
Composite	100.0	8.77	3.99	3.00		

TABLE A-19

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification UPPER SPADRA SEAM, JOHNSON COUNTY, ARKANSAS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2282

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.66	6.89	12.3	80.8	1.90	0.12	1.24	0.54	14,324

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	92.6	3.42	0.84	0.22	82.3	55.8
Sink at 1.60	7.4	52.2	13.4	11.5		
Composite	100.0	7.03	1.77	1.05		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	91.9	2.92	0.82	0.00	100.0	56.8
Sink at 1.60	8.1	50.9	13.6	12.3		
Composite	100.0	6.81	1.86	1.00		

TABLE A-20

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Coal Identification CHARLESTON SEAM, FRANKLIN COUNTY, ARKANSAS
Raw Run-of-Mine Coal Crushed to 1-1/2 Inch x 0

BCR Lot No. 2283

Chemical Analysis, As Received:

	Weight %, Dry Basis							
Moisture	Ash	Volatile Matter	Fixed Carbon	Total Sulfur	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur	Calorific Value, Btu/lb
0.43	9.96	19.4	70.6	3.67	0.13	2.92	0.62	13,978

Analyses of As-received Sample Reduced to Minus 30 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	90.4	4.84	2.70	1.86	36.3	26.4
Sink at 1.60	9.6	57.9	12.2	11.2		
Composite	100.0	9.93	3.61	2.76		

Analyses of As-received Sample Reduced to Minus 200 Mesh:

		Chemical Analysis, Dry Basis			Weight, % Reduction	
	Float and Sink, Weight, %	Ash	Total Sulfur	Pyritic Sulfur	Pyritic Sulfur	Total Sulfur
Float at 1.60	88.1	3.52	1.96	1.16	60.3	46.6
Sink at 1.60	11.9	57.0	15.7	14.7		
Composite	100.0	9.88	3.60	2.77		

Appendix B

PHASE II EVALUATIONS--CONCENTRATING TABLE

Moisture as reported on all Tables is the moisture of the sample as received in the analytical laboratory. This value is used to place other analyses on a dry basis.

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TABLE B-1

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification LOWER CHEROKEE SEAM, MARION COUNTY, IOWA

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 2415

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	35.3		1.16	9.78	3.54	
Zone B	17.6		0.88	7.24	3.02	
Zone C						
Float at 1.60	33.9	93.0	1.44	6.94	2.94	69.1
Sink at 1.60	2.5	7.0	1.10	41.92	14.74	40.3
Composite	36.4	100.0		9.39	3.77	67.08
Zone D						
Float at 1.60	2.9	65.6	3.53	9.00	3.24	66.8
1.60 by 2.95	1.4	30.6	0.92	50.9	15.5	25.7
Sink at 2.95	0.2	3.8	0.60	60.7	34.1	9.6
Composite	4.5	100.0		23.79	8.16	52.05
Zone E						
Float at 2.95	4.4	70.7	1.18	48.5	10.9	
Sink at 2.95	1.8	29.3	0.39	58.7	39.6	
Composite	6.2	100.0		51.49	19.31	
Composite of Zones A, B, C	89.3			9.12	3.53	
Composite of 1.60 Float Fractions	89.7			8.18	3.20	
Composite of 2.95 Sink Fractions	2.0			58.90	39.05	
Composite of Table Products	100.0			12.41	4.72	
Analysis of Feed to Table			6.39	12.8	5.12	

Run Date: 9-5-69

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TABLE B-2

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification LOWER CHEROKEE SEAM, MARION COUNTY, IOWA

Zones A, B, and C, 3/8 Inch x 0 Run (9-5-69) Crushed to 30 Mesh x 0

BCR Sample No. 2415

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	67.1		2.40	6.66	3.20	
Zone B	26.6		2.00	5.95	2.96	
Zone C						
Float at 1.60	1.77	98.1	1.54	7.04	3.14	
Sink at 1.60	0.03	1.9	1.20	48.6	23.0	
Composite	1.8	100.0		7.83	3.52	
Zone D						
Float at 1.60	2.6	68.7	2.64	12.0	4.48	
1.60 by 2.95	1.0	25.3	0.70	60.7	11.8	
Sink at 2.95	0.2	6.0	0.46	62.2	40.7	
Composite	3.8	100.0		27.33	8.51	
Zone E						
Float at 2.95	0.3	38.6	0.52	61.4	7.12	
Sink at 2.95	0.4	61.4	0.22	63.8	44.9	
Composite	0.7	100.0		62.9	30.32	
Composite of Zones A, B, C	95.5			6.48	3.14	
Composite of 1.60 Float Fractions	98.1			6.62	3.17	
Composite of 2.95 Sink Fractions	0.6			63.27	43.50	
Composite of Table Products	100.0			7.67	3.53	
Analysis of Feed to Table			17.0	7.42	3.42	

Run Date: 9-12-69

TABLE B-3

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests - Effects of Two-Stage Cleaning

Coal Identification LOWER CHEROKEE SEAM, MARION COUNTY, IOWA

Composite of 3/8 Inch x 0 Run (9-5-69) and 30 Mesh x 0 Run (9-12-69)

BCR Sample No. 2415

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	59.9		2.40	6.66	3.20	
Zone B	23.8		2.00	5.95	2.96	
Zone C						
Float at 1.60	1.57	98.1	1.54	7.04	3.14	
Sink at 1.60	0.03	1.9	1.20	48.6	23.0	
Composite	1.6	100.0		7.83	3.52	
Zone D						
Float at 1.60	5.2	65.8	3.14	10.33	3.79	
1.60 by 2.95	2.3	29.1	0.83	54.73	14.05	
Sink at 2.95	0.4	5.1	0.53	61.45	37.40	
Composite	7.9	100.0		25.86	8.49	
Zone E						
Float at 2.95	4.7	69.1	1.14	49.33	10.66	
Sink at 2.95	2.1	30.9	0.37	59.43	40.36	
Composite	6.8	100.0		52.45	19.84	
Composite of Zones A, B, C	85.3			6.48	3.14	
Composite of 1.60 Float Fractions	90.5			6.69	3.17	
Composite of 2.95 Sink Fractions	2.5			59.75	39.89	
Composite of Table Products	100.0			11.14	4.70	
Analysis of Feed to Table			17.0	12.8	5.12	

TABLE B-4

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification UPPER SPADRA SEAM, JOHNSON COUNTY, ARKANSAS

Raw R.O.M. Coal Crushed to 3/8 Inch x 0 Rough Cleaning

BCR Sample No. 2416

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	49.9		0.24	4.00	0.96	
Zone B	38.0		0.08	3.99	1.04	
Zone C						
Float at 1.60	6.1	72.0	0.25	5.56	1.40	
Sink at 1.60	2.4	28.0	0.24	50.4	8.58	
Composite	8.5	100.0		18.12	3.41	
Zone D						
Float at 1.60	0.2	10.9	0.45	7.76	2.26	
1.60 by 2.95	0.5	36.1	0.69	58.8	5.36	
Sink at 2.95	0.7	53.0	0.12	68.1	23.6	
Composite	1.4	100.0		58.17	14.69	
Zone E						
Float at 2.95	0.4	18.0	0.20	59.2	3.33	
Sink at 2.95	1.8	82.0	0.10	68.2	23.8	
Composite	2.2	100.0		66.58	20.12	
Composite of Zones A, B, C	96.4			5.24	1.21	
Composite of 1.60 Float Fractions	94.2			4.10	1.02	
Composite of 2.95 Sink Fractions	2.5			68.17	23.74	
Composite of Table Products	100.0			7.33	1.81	
Analysis of Feed to Table			1.10	6.50	1.59	

Run Date: 9-17-69

TABLE B-5

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification UPPER SPADRA SEAM, JOHNSON COUNTY, ARKANSAS

Zones A, B, and C, 3/8 Inch x 0 Run (9-17-69) Crushed to 30 Mesh x 0

BCR Sample No. 2416

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	71.9		0.30	3.72	0.96	
Zone B	23.0		0.38	3.74	0.99	
Zone C						
Float at 1.60	1.57	98.1	0.28	4.20	1.13	
Sink at 1.60	0.03	1.9	0.68	34.5	5.26	
Composite	1.6	100.0		4.78	1.21	
Zone D						
Float at 1.60	1.4	50.3	0.25	7.86	2.04	
1.60 by 2.95	1.1	40.7	0.88	52.4	4.56	
Sink at 2.95	0.3	9.0	0.26	70.5	9.93	
Composite	2.8	100.0		31.63	3.78	
Zone E						
Float at 2.95	0.3	39.4	0.53	64.4	3.74	
Sink at 2.95	0.4	60.6	0.20	68.9	18.4	
Composite	0.7	100.0		67.13	12.61	
Composite of Zones A, B, C	96.5			3.74	0.97	
Composite of 1.60 Float Fractions	97.9			3.79	0.98	
Composite of 2.95 Sink Fractions	0.7			69.59	14.77	
Composite of Table Products	100.0			4.97	1.13	
Analysis of Feed to Table			2.20	5.08	1.16	

Run Date: 9-26-69

TABLE B-6

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification UPPER SPADRA SEAM, JOHNSON COUNTY, ARKANSAS

Composite of 3/8 Inch x 0 Run (9-17-69) and 30 Mesh x 0 Run (9-26-69)

BCR Sample No. 2416

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	69.3		0.30	3.72	0.96	
Zone B	22.2		0.38	3.74	0.99	
Zone C						
Float at 1.60	1.47	98.1	0.28	4.20	1.13	
Sink at 1.60	0.03	1.9	0.68	34.5	5.26	
Composite	1.5	100.0		4.78	1.21	
Zone D						
Float at 1.60	1.5	36.6	0.28	7.85	2.07	
1.60 by 2.95	1.6	39.0	0.82	54.40	4.81	
Sink at 2.95	1.0	24.4	0.16	68.82	19.50	
Composite	4.1	100.0		40.88	7.39	
Zone E						
Float at 2.95	0.7	24.1	0.33	61.25	3.49	
Sink at 2.95	2.2	75.9	0.12	68.33	22.82	
Composite	2.9	100.0		66.62	18.16	
Composite of Zones A, B, C	93.0			3.74	0.97	
Composite of 1.60 Float Fractions	94.5			3.80	0.99	
Composite of 2.95 Sink Fractions	3.2			68.48	21.78	
Composite of Table Products	100.0			7.09	1.73	
Analysis of Feed to Table			1.10	6.50	1.59	

TABLE B-7

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 2417

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	38.6		1.66	18.2	4.19	
Zone B	30.3		1.20	15.7	4.36	
Zone C						
Float at 1.60	5.0	57.8	0.72	18.8	5.92	
Sink at 1.60	3.7	42.2	0.53	50.3	8.50	
Composite	8.7	100.0		32.10	7.01	
Zone D						
Float at 1.60	0.4	3.4	1.96	22.6	5.88	58.3
1.60 by 2.95	11.6	89.8	0.70	71.4	6.44	17.2
Sink at 2.95	0.9	6.8	0.71	69.2	29.0	7.9
Composite	12.9	100.0		69.59	7.96	17.97
Zone E						
Float at 2.95	4.2	43.7	0.39	78.6	7.34	
Sink at 2.95	5.3	56.3	0.17	65.4	39.8	
Composite	9.5	100.0		71.17	25.61	
Composite of Zones A, B, C	77.6			18.78	4.57	
Composite of 1.60 Float Fractions	74.3			17.24	4.38	
Composite of 2.95 Sink Fractions	6.2			65.95	38.23	
Composite of Table Products	100.0			30.31	7.01	
Analysis of Feed to Table			2.22	29.8	6.92	

Run Date: 10-3-69

TABLE B-8

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI

Zones A, B, and C, 3/8 Inch x 0 Run (10-3-69) Crushed to 30 Mesh x 0

BCR Sample No. 2417

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	67.6		0.57	11.8	4.36	
Zone B	24.5		0.46	10.9	4.12	
Zone C						
Float at 1.60	1.79	99.2	1.60	10.6	4.06	
Sink at 1.60	0.01	0.8	1.22	38.9	11.0	
Composite	1.8	100.0		10.83	4.12	
Zone D						
Float at 1.60	3.6	61.6	4.65	16.8	5.94	
1.60 by 2.95	2.1	34.9	0.60	53.4	9.92	
Sink at 2.95	0.2	3.5	0.28	66.4	27.1	
Composite	5.9	100.0		31.31	8.07	
Zone E						
Float at 2.95	0.02	12.3	0.39	67.2	8.76	
Sink at 2.95	0.18	87.7	0.15	65.4	40.1	
Composite	0.2	100.0		65.62	36.25	
Composite of Zones A, B, C	93.9			11.55	4.29	
Composite of 1.60 Float Fractions	97.5			11.74	4.35	
Composite of 2.95 Sink Fractions	0.4			65.90	33.60	
Composite of Table Products	100.0			12.82	4.58	
Analysis of Feed to Table			8.90	12.6	4.65	

Run Date: 10-17-69

TABLE B-9

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests - Effects of Two-Stage Cleaning

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI

Composite for 3/8 Inch x 0 Run (10-3-69) and 30 Mesh x 0 Run (10-17-69)

BCR Sample No. 2417

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	52.5		0.57	11.8	4.36	
Zone B	19.0		0.46	10.9	4.12	
Zone C						
Float at 1.60	1.39	99.2	1.60	10.6	4.06	
Sink at 1.60	0.01	0.8	1.22	38.9	11.0	
Composite	1.4	100.0		10.83	4.12	
Zone D						
Float at 1.60	3.2	18.3		17.53	5.93	
1.60 by 2.95	13.2	75.4		69.22	6.86	
Sink at 2.95	1.1	6.3		68.69	28.65	
Composite	17.5	100.0		59.73	8.06	
Zone E						
Float at 2.95	4.2	43.7		78.6	7.34	
Sink at 2.95	5.4	56.3		65.40	39.81	
Composite	9.6	100.0		71.17	25.62	
Composite of Zones A, B, C	72.9			11.55	4.29	
Composite of 1.60 Float Fractions	76.1			11.79	4.36	
Composite of 2.95 Sink Fractions	6.5			65.96	37.92	
Composite of Table Products	100.0			25.70	6.70	
Analysis of Feed to Table			2.22	29.8	6.92	

Appendix C

PHASE II EVALUATIONS--COMPOUND WATER CYCLONE

Moisture as reported on all Tables is the moisture of the sample as received in the analytical laboratory. This value is used to place other analyses on a dry basis.

TABLE C-1

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification LOWER CHEROKEE SEAM, MARION COUNTY, IOWA

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 2415

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	35.3		1.16	9.78	3.54	
Zone B	17.6		0.88	7.24	3.02	
Zone C						
Float at 1.60	33.9	93.0	1.44	6.94	2.94	69.1
Sink at 1.60	2.5	7.0	1.10	41.92	14.74	40.3
Composite	36.4	100.0		9.39	3.77	67.08
Zone D						
Float at 1.60	2.9	65.6	3.53	9.00	3.24	66.8
1.60 by 2.95	1.4	30.6	0.92	50.9	15.5	25.7
Sink at 2.95	0.2	3.8	0.60	60.7	34.1	9.6
Composite	4.5	100.0		23.79	8.16	52.05
Zone E						
Float at 2.95	4.4	70.7	1.18	48.5	10.9	
Sink at 2.95	1.8	29.3	0.39	58.7	39.6	
Composite	6.2	100.0		51.49	19.31	
Composite of Zones A, B, C	89.3			9.12	3.53	
Composite of 1.60 Float Fractions	89.7			8.18	3.20	
Composite of 2.95 Sink Fractions	2.0			58.90	39.05	
Composite of Table Products	100.0			12.41	4.72	
Analysis of Feed to Table			6.39	12.8	5.12	

Run Date: 9-5-69

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TABLE C-2

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification **LOWER CHEROKEE SEAM, MARION COUNTY, IOWA**

Zones A, B, and C, 3/8 Inch x 0 Run (9-5-69) Crushed to 30 Mesh x 0
Test No. 3, Run No. 1

BCR Sample No. 2415

Operating Conditions:

Cone Type	**3/8 in. orifice**	Specific Gravity, Pulp	1.04
Vortex Finder Clearance	**1 in.**	Flowrate of Pulp, usgpm	31.8
Inlet Pressure	**5 psi**	Specific Gravity, Solids	1.38
Dry Feed, tph	0.6	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	79.6	96.8	4.62	2.27
Sink at 1.60	2.6	3.2	34.4	13.4
Composite	82.2	100.0	5.57	2.63
Underflow				
Float at 1.60	15.6	87.7	6.34	2.88
Sink at 1.60	2.2	12.3	60.0	16.4
Composite	17.8	100.0	12.94	4.54
Composite of Cyclone Products	100.0		6.88	2.97
Analysis of Feed to Cyclone			7.39	3.24

Run Date: 10-30-69

TABLE C-3

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Compound Water Cyclone Tests
Effects of Two-Stage Cleaning

Coal Identification LOWER CHEROKEE SEAM, MARION COUNTY, IOWA

BCR Sample No. 2415

Concentrating Table Test Run Date 9-5-69

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table		12.8	5.12		
Composite of Zones A, B, C	89.3	9.12	3.53	28.7	31.1

Compound Water Cyclone Test No. 3, Run No. 1 Run Date 10-30-69

Feed to Compound Water Cyclone: Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of * Feed to CWC		6.88	2.97		
Clean Coal Product	82.2	5.57	2.63	19.0	11.4
Two-Stage Clean Coal Product	73.4	5.57	2.63	56.5	48.6

* Based on Composite of CWC Products

TABLE C-4

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification UPPER SPADRA SEAM, JOHNSON COUNTY, ARKANSAS

Raw R.O.M. Coal Crushed to 3/8 Inch x 0 Rough Cleaning

BCR Sample No. 2416

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	49.9		0.24	4.00	0.96	
Zone B	38.0		0.08	3.99	1.04	
Zone C						
Float at 1.60	6.1	72.0	0.25	5.56	1.40	
Sink at 1.60	2.4	28.0	0.24	50.4	8.58	
Composite	8.5	100.0		18.12	3.41	
Zone D						
Float at 1.60	0.2	10.9	0.45	7.76	2.26	
1.60 by 2.95	0.5	36.1	0.69	58.8	5.36	
Sink at 2.95	0.7	53.0	0.12	68.1	23.6	
Composite	1.4	100.0		58.17	14.69	
Zone E						
Float at 2.95	0.4	18.0	0.20	59.2	3.33	
Sink at 2.95	1.8	82.0	0.10	68.2	23.8	
Composite	2.2	100.0		66.58	20.12	
Composite of Zones A, B, C	96.4			5.24	1.21	
Composite of 1.60 Float Fractions	94.2			4.10	1.02	
Composite of 2.95 Sink Fractions	2.5			68.17	23.74	
Composite of Table Products	100.0			7.33	1.81	
Analysis of Feed to Table			1.10	6.50	1.59	

Run Date: 9-17-69

TABLE C-5

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification UPPER SPADRA SEAM, JOHNSON COUNTY, ARKANSAS

Zones A, B, and C, 3/8 Inch x 0 Run (9-17-69) Crushed to 30 Mesh x 0
Test No. 2, Run No. 1

BCR Sample No. 2416

Operating Conditions:

Cone Type	3/8 in. orifice	Specific Gravity, Pulp	1.02
Vortex Finder Clearance	1 in.	Flowrate of Pulp, usgpm	31.8
Inlet Pressure	5 psi	Specific Gravity, Solids	1.34
Dry Feed, tph	0.6	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	90.3	96.7	3.08	0.88
Sink at 1.60	3.1	3.3	30.2	4.28
Composite	93.4	100.0	3.97	0.99
Underflow				
Float at 1.60	5.8	87.4	4.12	1.24
Sink at 1.60	0.8	12.6	62.1	6.16
Composite	6.6	100.0	11.43	1.86
Composite of Cyclone Products	100.0		4.46	1.05
Analysis of Feed to Cyclone			4.68	1.02

Run Date: 10-30-69

TABLE C-6

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Compound Water Cyclone Tests
Effects of Two-Stage Cleaning

Coal Identification UPPER SPADRA SEAM, JOHNSON COUNTY, ARKANSAS

BCR Sample No. 2416

Concentrating Table Test Run Date 9-17-69

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table		6.50	1.59		
Composite of Zones A, B, C	96.4	5.24	1.21	19.4	23.9

Compound Water Cyclone Test No. 2, Run No. 1 Run Date 10-30-69

Feed to Compound Water Cyclone: Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to CWC *		4.46	1.05		
Clean Coal Product	93.4	3.97	0.99	11.0	5.7
Two-Stage Clean Coal Product	90.0	3.97	0.99	38.9	37.7

* Based on Composite of CWC Products

TABLE C-7

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Rough Cleaning

BCR Sample No. 2417

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	38.6		1.66	18.2	4.19	
Zone B	30.3		1.20	15.7	4.36	
Zone C						
Float at 1.60	5.0	57.8	0.72	18.8	5.92	
Sink at 1.60	3.7	42.2	0.53	50.3	8.50	
Composite	8.7	100.0		32.10	7.01	
Zone D						
Float at 1.60	0.4	3.4	1.96	22.6	5.88	58.3
1.60 by 2.95	11.6	89.8	0.70	71.4	6.44	17.2
Sink at 2.95	0.9	6.8	0.71	69.2	29.0	7.9
Composite	12.9	100.0		69.59	7.96	17.97
Zone E						
Float at 2.95	4.2	43.7	0.39	78.6	7.34	
Sink at 2.95	5.3	56.3	0.17	65.4	39.8	
Composite	9.5	100.0		71.17	25.61	
Composite of Zones A, B, C	77.6			18.78	4.57	
Composite of 1.60 Float Fractions	74.3			17.24	4.38	
Composite of 2.95 Sink Fractions	6.2			65.95	38.23	
Composite of Table Products	100.0			30.31	7.01	
Analysis of Feed to Table			2.22	29.8	6.92	

Run Date: 10-3-69

TABLE C-8

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification **TEBO SEAM, HENRY COUNTY, MISSOURI**

Zones A, B, and C, 3/8 Inch x 0 Run (10-3-69) Crushed to 30 Mesh x 0
Test No. 1, Run No. 1

BCR Sample No. 2417

Operating Conditions:

Cone Type	3/8 in. orifice	Specific Gravity, Pulp	1.03
Vortex Finder Clearance	1 in.	Flowrate of Pulp, usgpm	39.6
Inlet Pressure	7 psi	Specific Gravity, Solids	1.48
Dry Feed, tph	0.7	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	82.1	95.8	9.30	3.52
Sink at 1.60	3.6	4.2	42.6	12.0
Composite	85.7	100.0	10.70	3.88
Underflow				
Float at 1.60	12.7	88.6	10.8	4.22
Sink at 1.60	1.6	11.4	50.0	14.3
Composite	14.3	100.0	15.27	5.37
Composite of Cyclone Products	100.0		11.35	4.09
Analysis of Feed to Cyclone			12.5	4.44

Run Date: 10-30-69

TABLE C-9

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Compound Water Cyclone Tests
Effects of Two-Stage Cleaning

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI

BCR Sample No. 2417

Concentrating Table Test

Run Date 10-3-69

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table		29.8	6.92		
Composite of Zones A, B, C	77.6	18.78	4.57	37.0	34.0

Compound Water Cyclone Test No. 1, Run No. 1 Run Date 10-30-60

Feed to Compound Water Cyclone: Zones A, B, and C, Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to CWC *		11.35	4.09		
Clean Coal Product	85.7	10.70	3.88	5.7	5.1
Two-Stage Clean Coal Product	66.5	10.70	3.88	64.1	43.9

* Based on Composite of CWC Products

TABLE C-10

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification **TEBO SEAM, HENRY COUNTY, MISSOURI**

Zones A, B, and C, 3/8 Inch x 0 Run (10-3-69) Crushed to 30 Mesh x 0
Test No. 1, Run No. 2

BCR Sample No. 2417

Operating Conditions:

Cone Type	3/8 in. orifice	Specific Gravity, Pulp	1.03
Vortex Finder Clearance	1 in.	Flowrate of Pulp, usgpm	55.2
Inlet Pressure	8 psi	Specific Gravity, Solids	1.48
Dry Feed, tph	1.1	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
Overflow				
Float at 1.60	84.8	96.6	8.66	3.48
Sink at 1.60	3.0	3.4	39.2	10.8
Composite	87.8	100.0	9.70	3.73
Underflow				
Float at 1.60	10.1	83.1	11.3	4.38
Sink at 1.60	2.1	16.9	51.8	13.2
Composite	12.2	100.0	18.14	5.87
Composite of Cyclone Products	100.0		10.73	3.99
Analysis of Feed to Cyclone			12.2	4.43

Run Date: 10-30-69

TABLE C-11

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Compound Water Cyclone Tests
Effects of Two-Stage Cleaning

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI

BCR Sample No. 2417

Concentrating Table Test

Run Date 10-3-69

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table		29.8	6.92		
Composite of Zones A, B, C	77.6	18.78	4.57	37.0	34.0

Compound Water Cyclone Test No. 1, Run No. 2 Run Date 10-30-69

Feed to Compound Water Cyclone: Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to CWC *		10.73	3.99		
Clean Coal Product	87.8	9.70	3.72	9.6	6.8
Two-Stage Clean Coal Product	68.1	9.70	3.72	67.4	46.2

* Based on Composite of CWC Products

TABLE C-12

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Compound Water Cyclone Tests

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI

Zones A, B, and C, 3/8 Inch x 0 Run (10-3-69) Crushed to 30 Mesh x 0

Test No. 1, Run No. 3

BCR Sample No. 2417

Operating Conditions:

Cone Type/Orifice Size	3/8 in.	Specific Gravity, Pulp	1.03
Vortex Finder Clearance	1 in.	Flowrate of Pulp, usgpm	39.6
Inlet Pressure	7 psi	Specific Gravity, Solids	1.48
Dry Feed, tph	0.7	Weight Percent, Solids	8.0

Cyclone Products	Product, Weight Percent	Float and Sink, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent: Ash	Chemical Analysis, Dry Basis, Weight Percent: Total Sulfur
Overflow				
Float at 1.60	85.4	94.0	8.97	3.44
Sink at 1.60	5.5	6.0	39.2	11.2
Composite	90.9	100.0	10.78	3.91
Underflow				
Float at 1.60	7.8	86.1	10.5	4.16
Sink at 1.60	1.3	13.9	52.3	15.7
Composite	9.1	100.0	16.31	5.76
Composite of Cyclone Products	100.0		11.28	4.08
Analysis of Feed to Cyclone			12.2	4.43

Run Date: 10-3-69

TABLE C-13

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table and Compound Water Cyclone Tests
Effects of Two-Stage Cleaning

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI

BCR Sample No. 2417

Concentrating Table Test

Run Date 10-3-69

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to Table		29.8	6.92		
Composite of Zones A, B, C	77.6	18.78	4.57	37.0	34.0

Compound Water Cyclone Test No. 1, Run No. 3 Run Date 10-30-69

Feed to Compound Water Cyclone: Zones A, B, and C Crushed to 30 Mesh x 0

	Product Weight %	Chemical Analysis, Dry Basis, Weight %		Weight % Reduction	
		Ash	Total Sulfur	Ash	Total Sulfur
Analysis of Feed to CWC *		11.28	4.08		
Clean Coal Product	90.9	10.78	3.91	4.4	4.2
Two-Stage Clean Coal Product	70.5	10.78	3.91	63.8	43.5

* Based on Composite of CWC Products

Appendix D

PHASE IV EVALUATIONS--PYRITE CONCENTRATION

Moisture as reported on all Tables
is the moisture of the sample as
received in the analytical laboratory.
This value is used to place other
analyses on a dry basis.

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TABLE D-1

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0,
Pyrite Precleaning

BCR Sample No. 2234

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	40.2		1.65	6.50	0.76	
Zone B	30.3		0.92	6.90	0.88	
Zone C						
Float at 1.60	13.6	98.0	1.05	7.68	0.98	
Sink at 1.60	0.3	2.0	1.20	45.4	4.42	
Composite	13.9	100.0		8.43	1.05	
Zone D						
Float at 1.60	4.34	71.2	0.99	15.9	1.84	33.5
1.60 by 2.95	1.72	28.2	1.06	44.4	4.60	41.6
Sink at 2.95	0.04	0.6	1.66	63.4	26.6	13.9
Composite	6.1	100.0		24.22	2.77	35.67
Zone E						
Float at 2.95	5.9	62.1	0.44	65.9	7.42	
Sink at 2.95	3.6	37.9	0.37	61.4	42.5	
Composite	9.5	100.0		64.19	20.72	
Composite of Zones A, B, C	84.4			6.96	0.85	
Composite of 1.60 Float Fractions	88.4			7.27	0.89	
Composite of 2.95 Sink Fractions	3.6			61.42	42.33	
Composite of Table Products	100.0			13.45	2.86	
Analysis of Feed to Table			3.08	14.8	3.19	

Run Date: 7-1-69

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TABLE D-2

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Zone E, 3/8 Inch x 0 Run (7-1-69) Crushed to 30 Mesh x 0

BCR Sample No. 2234

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
		Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	52.9	0.96	52.2	6.28	
Zone B	3.2	0.72	71.6	6.72	
Zone C	0.5	0.99	69.6	14.10	
Zone D	29.2	0.25	72.4	25.40	6.9
Zone E	14.2	0.10	64.4	48.60	3.9
Composite of Table Products	100.0		60.54	17.93	
Analysis of Feed to Table		0.41	64.19	20.72	

Run Date: 7-28-69

TABLE D-3

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Zone D, 30 Mesh x 0 Run (7-28-69) Crushed to 60 Mesh x 0

BCR Sample No. 2234

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
		Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	36.3	1.52	72.4	17.5	
Zone B	15.0	0.95	72.8	16.8	
Zone C	7.5	0.60	73.2	16.8	
Zone D	34.3	0.58	71.2	30.5*	4.4
Zone E	6.9	0.20	65.4	48.5	1.9
Composite of Table Products	100.0		71.63	23.94	
Analysis of Feed to Table		0.25	72.40	25.40	

* Cut Between Zones D and E Should Have Favored Zone D More Than It Did

Run Date: 8-21-69

TABLE D-4

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Pyrite Beneficiation - Effects of Two-stage Cleaning

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

BCR Sample No. 2234

Pyrite Precleaning

Concentrating Table No. 14 Test Run Date 7-1-69

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	14.80	3.19
Zone E (Pyrite Zone)	9.5	64.19	20.72

Pyrite Cleaning

Concentrating Table No. 15-S Test Run Date 7-28-69

Feed to Concentrating Table: Zone E, 3/8 Inch x 0 Run (7-1-69) Crushed to 30 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	64.19	20.72
Zone E (Pyrite Zone)	14.2	64.40	48.60

Concentrating Table No. 15-S Test Run Date 8-21-69

Feed to Concentrating Table: Zone D, 30 Mesh x 0 Run (7-28-69) Crushed to 60 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	72.40	23.94
Zone E (Pyrite Zone)	6.9	65.40	48.50

Two Stage Pyrite Product	1.5	64.53	48.59

TABLE D-5

Flowsheet for Pyrite Beneficiation Tests, Phase IV

Ohio No. 6 Seam, Columbiana County, Ohio
BCR Sample No. 2234

Pounds of Total Sulfur/Ton of
Run-of-Mine Coal

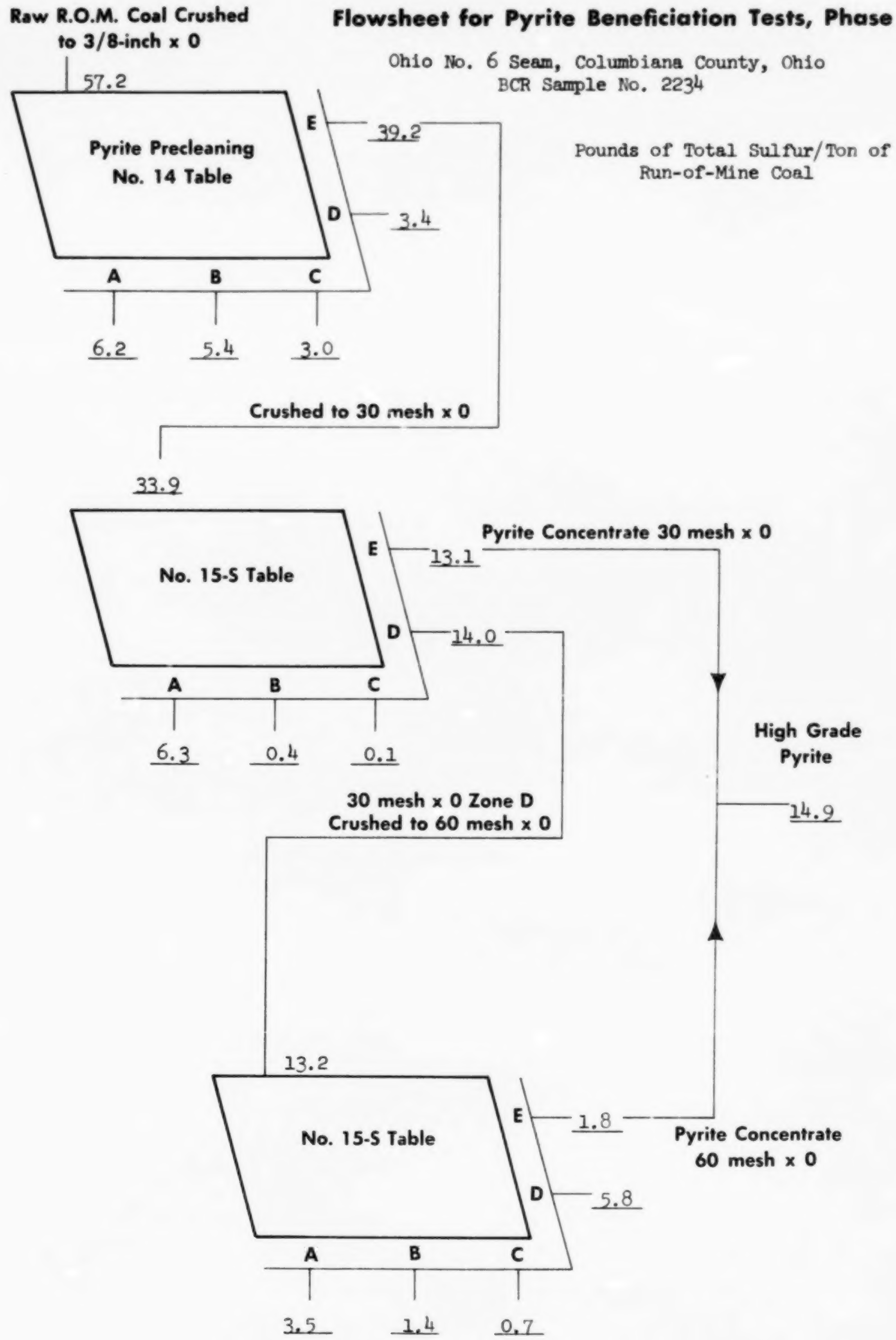

Raw R.O.M. Coal Crushed to 3/8-inch x 0
57.2
Pyrite Precleaning No. 14 Table
E
39.2
D
3.4
A
B
C
6.2
5.4
3.0
Crushed to 30 mesh x 0
33.9
No. 15-S Table
E
13.1
Pyrite Concentrate 30 mesh x 0
D
14.0
A
B
C
6.3
0.4
0.1
High Grade Pyrite
14.9
30 mesh x 0 Zone D Crushed to 60 mesh x 0
13.2
No. 15-S Table
E
1.8
Pyrite Concentrate 60 mesh x 0
D
5.8
A
B
C
3.5
1.4
0.7

TABLE D-6

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Flowsheet Data for Pyrite Beneficiation Tests, Phase IV

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

BCR Sample No. 2234

Fraction	Weight Percent		Chemical Analysis, Dry Basis Weight Percent	
			Ash	Total Sulfur
Table No. 14				
Zone A	40.2		6.50	0.76
Zone B	30.3		6.90	0.88
Zone C	13.9		8.43	1.05
Zone D	6.1		24.22	2.77
Zone E		9.5	64.19	20.72
Table No. 15-S (30 Mesh x 0)				
Zone A	5.0		52.2	6.28
Zone B	0.3		71.6	6.72
Zone C	0.1		69.6	14.10
Zone D		2.8	72.4	25.40
Zone E	1.3		64.4	48.60
Table No. 15-S (60 Mesh x 0)				
Zone A	1.0		72.4	17.5
Zone B	0.4		72.8	16.8
Zone C	0.2		73.2	16.8
Zone D	1.0		71.2	30.5
Zone E	0.2		65.4	48.5
Composite of Fractions	100.0		13.09	2.54
Analysis of Feed Coal			14.8	3.19

TABLE D-7

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Pyrite Precleaning

BCR Sample No. 2234

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	40.2		1.65	6.50	0.76	
Zone B	30.3		0.92	6.90	0.88	
Zone C						
Float at 1.60	13.6	98.0	1.05	7.68	0.98	
Sink at 1.60	0.3	2.0	1.20	45.4	4.42	
Composite	13.9	100.0		8.43	1.05	
Zone D						
Float at 1.60	4.34	71.2	0.99	15.9	1.84	33.5
1.60 by 2.95	1.72	28.2	1.06	44.4	4.60	41.6
Sink at 2.95	0.04	0.6	1.66	63.4	26.6	13.9
Composite	6.1	100.0		24.22	2.77	35.67
Zone E						
Float at 2.95	5.9	62.1	0.44	65.9	7.42	
Sink at 2.95	3.6	37.9	0.37	61.4	42.5	
Composite	9.5	100.0		64.19	20.72	
Composite of Zones A, B, C	84.4			6.96	0.85	
Composite of 1.60 Float Fractions	88.4			7.27	0.89	
Composite of 2.95 Sink Fractions	3.6			61.42	42.33	
Composite of Table Products	100.0			13.45	2.86	
Analysis of Feed to Table			3.08	14.8	3.19	

Run Date: 7-1-69

TABLE D-8

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Zone E, 3/8 Inch x 0 Run (7-1-69) Crushed to 30 Mesh x 0

BCR Sample No. 2234

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
		Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	52.9	0.96	52.2	6.28	
Zone B	3.2	0.72	71.6	6.72	
Zone C	0.5	0.99	69.6	14.10	
Zone D	29.2	0.25	72.4	25.40	6.9
Zone E	14.2	0.10	64.4	48.60	3.9
Composite of Table Products	100.0		60.54	17.93	
Analysis of Feed to Table			64.19	20.72	

Run Date: 7-28-69

TABLE D-9

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Hydraulic Classifier Tests - Pyrite Beneficiation

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Zone D, 30 Mesh x 0 Run (7-28-69) Crushed to 60 Mesh x 0

BCR Sample No. 2234

Classifier Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent		
		Moisture	Ash	Total Sulfur
Overflow Slimes	34.7	0.56	72.8	19.2
Deslimed Product	65.3	0.30	71.8	26.4
Composite of Classifier Products	100.0		72.15	23.9
Analysis of Feed to Classifier		1.50	72.4	25.4

Run Date: 8-5-69

TABLE D-10

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

Zone D, 30 Mesh x 0 Run (7-28-69) Crushed to 60 Mesh x 0, Classifier Deslimed Product (8-5-69)

BCR Sample No. 2234

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
		Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	8.5	0.51	72.6	15.0	
Zone B	1.5	0.78	72.6	14.6	
Zone C	6.7	0.34	73.4	14.8	
Zone D	66.4	0.39	73.1	24.2	6.4
Zone E	16.9	0.10	66.2	46.8	2.2
Composite of Table Products	100.0		71.9	26.5	
Analysis of Feed to Table		0.30	71.8	26.4	

Run Date: 8-21-69

TABLE D-11

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Pyrite Beneficiation - Effects of Two-stage Cleaning

Coal Identification OHIO NO. 6, COLUMBIANA COUNTY, OHIO

BCR Sample No. 2234

Pyrite Precleaning

Concentrating Table No. 14 Test Run Date 7-1-69
Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight % Ash	Total Sulfur
Analysis of Feed to Table	100.0	14.80	3.19
Zone E (Pyrite Zone)	9.5	64.19	20.72

Pyrite Cleaning

Concentrating Table No. 15-S Test Run Date 7-28-69
Feed to Concentrating Table: Zone E, 3/8 Inch x 0 Run (7-1-69) Crushed to 30 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight % Ash	Total Sulfur
Analysis of Feed to Table	100.0	64.19	20.72
Zone E (Pyrite Zone)	14.2	64.40	48.60

Concentrating Table No. 15-S Test Run Date 8-21-69
Feed to Concentrating Table: Zone D, 30 Mesh x 0 Run (7-28-69) Crushed to 60 Mesh x 0, Classifier Product

	Product, Weight %	Chemical Analysis, Dry Basis, Weight % Ash	Total Sulfur
Analysis of Feed to Table	100.0	71.80	26.40
Zone E (Pyrite Zone)	16.9	66.20	46.80
Two Stage Pyrite Product	1.6	64.70	48.30

TABLE D-12

Flowsheet for Pyrite Beneficiation Tests, Phase IV
Hydraulic Classifier in System

Ohio No. 6 Seam, Columbiana County,
Ohio BCR Sample No. 2234

Pounds of Total Sulfur/Ton of
Run-of-Mine Coal

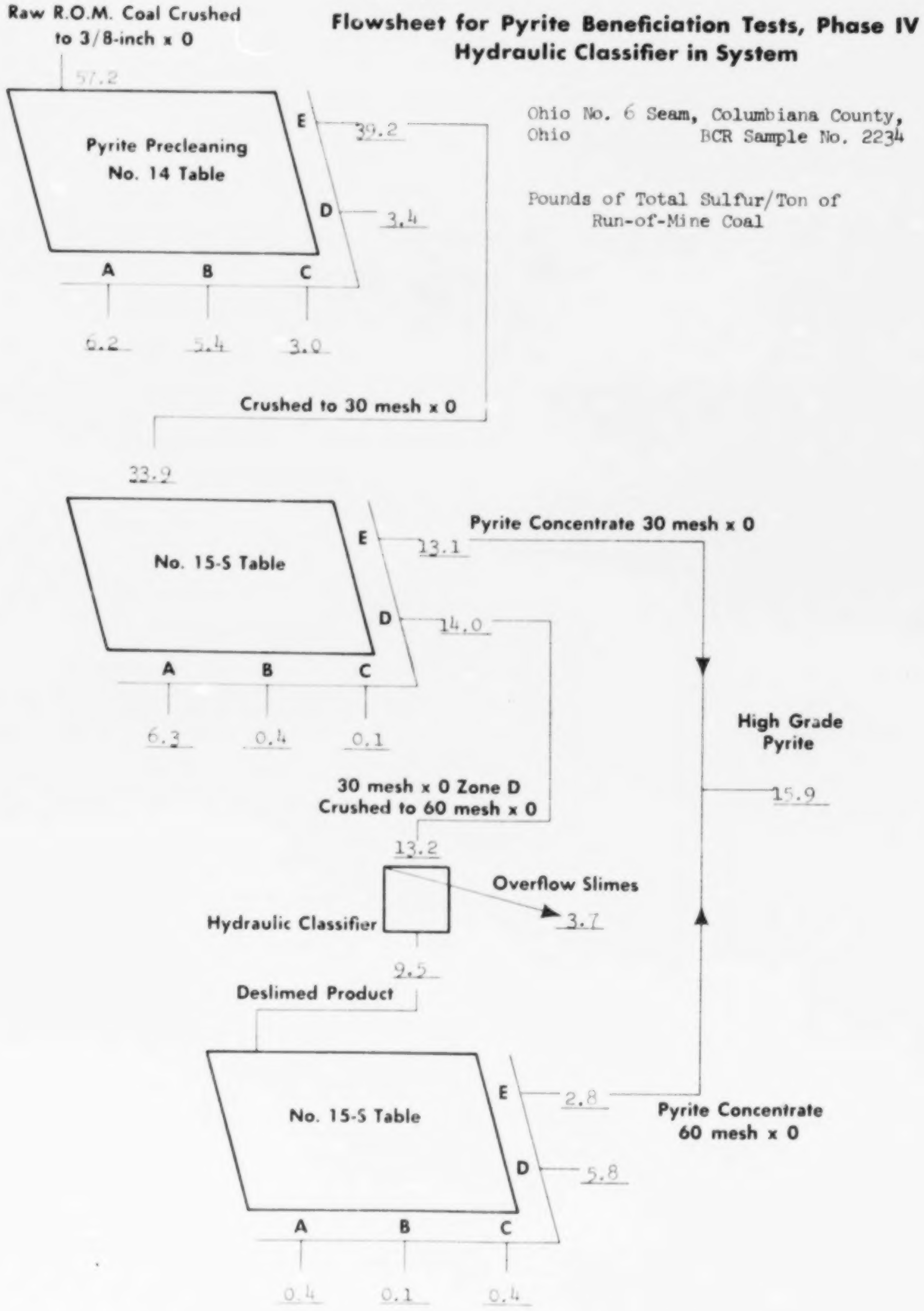

Raw R.O.M. Coal Crushed to 3/8-inch x 0
57.2
Pyrite Precleaning No. 14 Table
E
39.2
D
3.4
A
B
C
6.2
5.4
3.0
Crushed to 30 mesh x 0
33.9
No. 15-S Table
E
13.1
Pyrite Concentrate 30 mesh x 0
D
14.0
A
B
C
6.3
0.4
0.1
High Grade Pyrite
15.9
30 mesh x 0 Zone D Crushed to 60 mesh x 0
13.2
Overflow Slimes
3.7
Hydraulic Classifier
9.5
Deslimed Product
No. 15-S Table
E
2.8
Pyrite Concentrate 60 mesh x 0
D
5.8
A
B
C
0.4
0.1
0.4

TABLE D-13

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Flowsheet Data for Pyrite Beneficiation Tests, Phase IV

Coal Identification OHIO NO. 6 SEAM, COLUMBIANA COUNTY, OHIO

BCR Sample No. 2234

Fraction	Weight Percent		Chemical Analysis, Dry Basis, Weight Percent	
			Ash	Total Sulfur
3/8 Inch x 0 R.O.M. Coal Processed on Model No. 14 Concentrating Table				
Zone A	40.2		6.50	0.76
Zone B	30.3		6.90	0.88
Zone C	13.9		8.43	1.05
Zone D	6.1		24.22	2.77
Zone E		9.5*	64.19	20.72
3/8 Inch x 0, Zone E, Material, Pulverized to Minus 30 Mesh and Processed on 15S Metallurgical Table				
Zone A	5.0		52.2	6.28
Zone B	0.3		71.6	6.72
Zone C	0.1		69.6	14.10
Zone D		2.8*	72.4	25.40
Zone E	1.3		64.4	48.60
30 Mesh x 0 Zone E Material Deslimed in Hydraulic Classifier				
Overflow Slimes	1.0		72.8	19.2
Deslimed Product		1.8*	71.8	26.4
30 Mesh x 0 Deslimed Product Pulverized to Minus 60 Mesh and Processed on 15S Metallurgical Table				
Zone A	0.2		72.6	15.0
Zone B	0.03		72.6	14.6
Zone C	0.1		73.4	14.8
Zone D	1.2		73.1	24.2
Zone E	0.3		66.2	46.8
Composite of Fractions	100.0		12.40	2.54
Analysis of Feed Coal			14.8	3.19

* Portion of total sample removed for subsequent processing.

TABLE D-14

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification UPPER KITTANNING SEAM, SOMERSET COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Pyrite Precleaning

BCR Sample No. 2255

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	31.7		0.38	8.99	0.84	
Zone B	34.1		0.27	7.82	0.88	
Zone C						
Float at 1.60	5.2	96.6	0.25	8.27	0.88	
Sink at 1.60	0.2	3.4	0.51	51.2	5.35	
Composite	5.4	100.0		9.73	1.03	
Zone D						
Float at 1.60	3.9	72.9	0.38	15.8	1.50	75.2
1.60 by 2.95	1.4	26.0	0.48	41.4	5.05	46.8
Sink at 2.95	0.1	1.1	0.59	71.8	17.6	12.0
Composite	5.4	100.0		23.07	2.60	67.12
Zone E						
Float at 2.95	21.1	90.2	0.20	77.0	2.22	
Sink at 2.95	2.3	9.8	0.34	64.2	35.5	
Composite	23.4	100.0		75.75	5.48	
Composite of Zones A, B, C	71.2			8.49	0.87	
Composite of 1.60 Float Fractions	74.9			8.76	0.90	
Composite of 2.95 Sink Fractions	2.4			64.51	34.75	
Composite of Table Products	100.0			25.01	2.04	
Analysis of Feed to Table			2.33	23.7	2.02	

Run Date: 7-15-69

TABLE D-15

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification UPPER KITTANNING SEAM, SOMERSET COUNTY, PENNSYLVANIA

Zone E 3/8 Inch x 0 Run (7-15-69) Crushed to 30 Mesh x 0

BCR Sample No. 2255

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
		Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	21.1	0.26	69.0	2.16	
Zone B	14.9	0.20	65.2	1.94	
Zone C	2.9	0.54	73.9	3.16	
Zone D	51.1	0.02	83.2	2.56	8.7
Zone E	10.0	0.08	69.2	35.7	4.9
Composite of Table Products	100.0		75.85	5.71	
Analysis of Feed to Table		0.21	75.75	5.48	

Run Date: 9-19-69

TABLE D-16

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Mine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification UPPER KITTANNING SEAM, SOMERSET COUNTY, PENNSYLVANIA

Zone D, 30 Mesh x 0 Run (9-19-69) Crushed to 60 Mesh x 0

BCR Sample No. 2255

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
		Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	4.0	0.86	82.6	1.90	
Zone B	32.6	0.94	82.8	2.00	
Zone C	17.0	0.48	82.8	1.88	
Zone D	44.1	0.40	84.8	2.68	7.36
Zone E	2.3	0.30	70.6	35.2	4.4
Composite of Table Products	100.0		83.39	3.04	
Analysis of Feed to Table		0.02	83.2	2.56	

Run Date: 9-29-69

TABLE D-17

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Pyrite Beneficiation - Effects of Two-stage Cleaning

Coal Identification UPPER KITTANNING SEAM, SOMERSET COUNTY, PENNSYLVANIA

BCR Sample No. 2255

Pyrite Precleaning

Concentrating Table No. 14 Test Run Date 7-15-69
Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	23.7	2.02
Zone E (Pyrite Zone)	23.4	75.75	5.48

Pyrite Cleaning

Concentrating Table No. 15-S Test Run Date 9-19-69
Feed to Concentrating Table: Zone E 3/8 Inch x 0 Run (7-15-69) Crushed to 30 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	75.75	5.48
Zone E (Pyrite Zone)	10.0	69.20	35.70

Concentrating Table No. 15-S Test Run Date 9-29-69
Feed to Concentrating Table: Zone D, 30 Mesh x 0 Run (9-19-69) Crushed to 60 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	83.20	2.56
Zone E (Pyrite Zone)	2.3	70.60	35.20

Two Stage Pyrite Product	2.6	69.36	35.64

TABLE D-18

Flowsheet for Pyrite Beneficiation Tests, Phase IV

Upper Kittanning Seam, Somerset County, Pa.
BCR Sample No. 2255

Pounds of Total Sulfur/Ton of
Run-of-Mine Coal

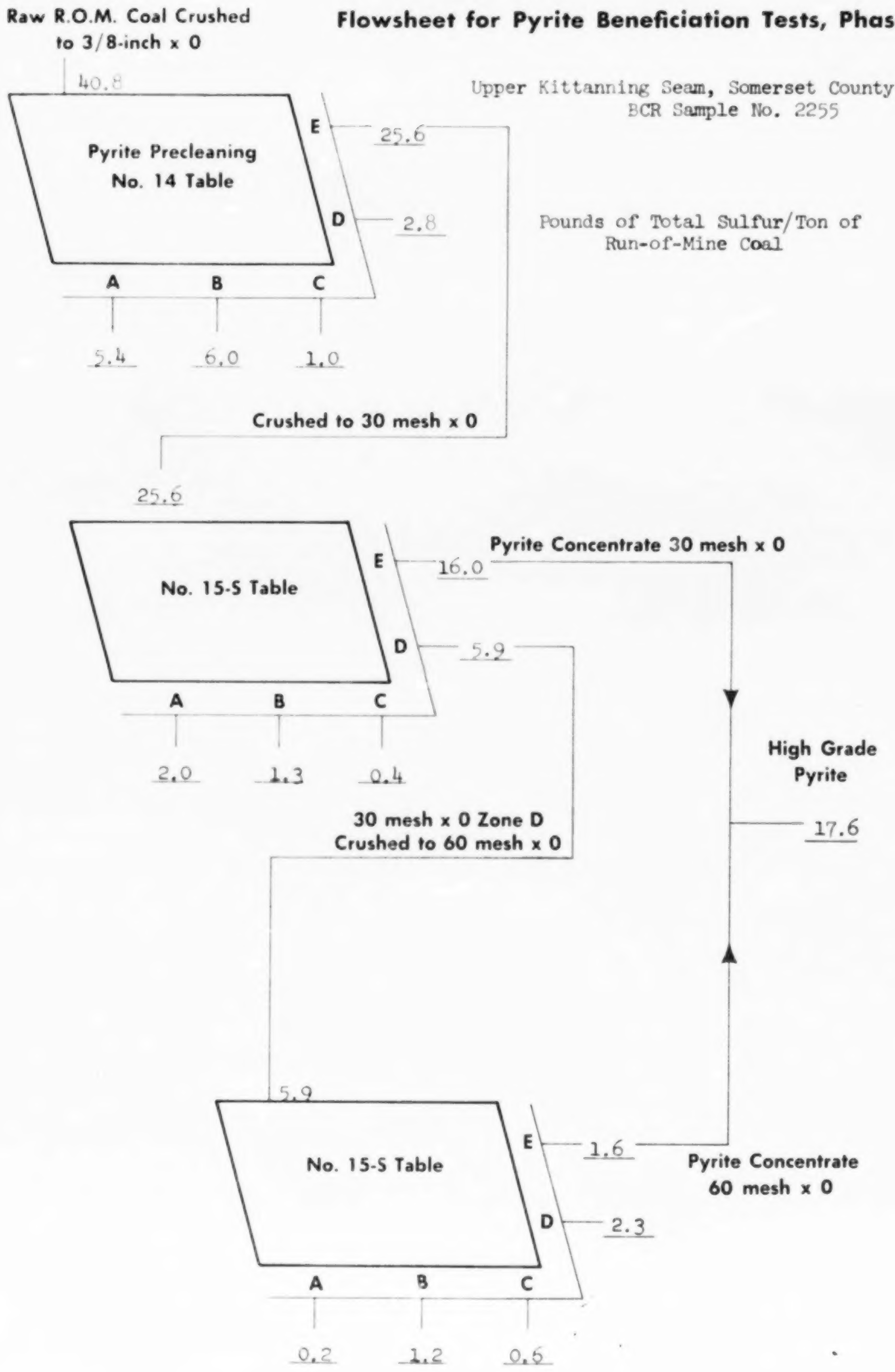

Raw R.O.M. Coal Crushed to 3/8-inch x 0
40.8
Pyrite Precleaning No. 14 Table
E
25.6
D
2.8
A
B
C
5.4
6.0
1.0
Crushed to 30 mesh x 0
25.6
No. 15-S Table
E
16.0
Pyrite Concentrate 30 mesh x 0
D
5.9
A
B
C
2.0
1.3
0.4
High Grade Pyrite
17.6
30 mesh x 0 Zone D
Crushed to 60 mesh x 0
5.9
No. 15-S Table
E
1.6
Pyrite Concentrate 60 mesh x 0
D
2.3
A
B
C
0.2
1.2
0.6

TABLE D-19

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Flowsheet Data for Pyrite Beneficiation Tests, Phase IV

Coal Identification UPPER KITTANNING SEAM, SOMERSET COUNTY, PENNSYLVANIA

BCR Sample No. 2255

Fraction	Weight Percent		Chemical Analysis, Dry Basis Weight Percent	
			Ash	Total Sulfur
3/8 Inch x 0 R.O.M. Coal Processed on No. 14 Concentrating Table				
Zone A	31.7		8.99	0.84
Zone B	34.1		7.82	0.88
Zone C	5.4		9.73	1.03
Zone D	5.4		23.07	2.60
Zone E		23.4	75.75	5.48
3/8 Inch x 0, Zone E, Material Pulverized to Minus 30 Mesh and Processed on 15S Metallurgical Table				
Zone A	4.9		69.0	2.16
Zone B	3.5		65.2	1.94
Zone C	0.7		73.9	3.16
Zone D		12.0	83.2	2.56
Zone E	2.3		69.2	35.7
30 Mesh x 0, Zone E, Material Pulverized to Minus 60 Mesh and Processed on 15S Metallurgical Table				
Zone A	0.5		82.6	1.90
Zone B	3.9		82.8	2.00
Zone C	2.0		82.8	1.88
Zone D	5.3		84.8	2.68
Zone E	0.3		70.6	35.2
Composite of Fractions	100.0		25.06	2.15
Analysis of Feed Coal			23.7	2.02

TABLE D-20

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification COAL VII, SULLIVAN COUNTY, INDIANA

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0 Pyrite Precleaning

BCR Sample No. 2287

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	34.3		3.58	15.0	0.76	
Zone B	42.7		3.78	9.89	0.76	
Zone C						
Float at 1.60	11.7	94.7	4.68	7.72	0.76	
Sink at 1.60	0.7	5.3	1.39	65.1	1.53	
Composite	12.4	100.0		10.76	0.80	
Zone D						
Float at 1.60	4.9	53.6	1.90	17.7	0.94	32.2
1.60 by 2.95	3.9	42.5	1.07	67.4	3.46	19.7
Sink at 2.95	0.4	3.9	0.64	75.2	19.9	6.9
Composite	9.2	100.0		41.07	2.75	25.90
Zone E						
Float at 2.95	1.1	76.8	1.44	73.2	2.52	
Sink at 2.95	0.3	23.2	0.40	67.6	36.4	
Composite	1.4	100.0		71.90	10.38	
Composite of Zones A, B, C	89.4			11.97	0.77	
Composite of 1.60 Float Fractions	93.6			11.90	0.77	
Composite of 2.95 Sink Fractions	0.7			71.94	26.98	
Composite of Table Products	100.0			15.5	1.08	
Analysis of Feed to Table			7.16	15.1	1.00	

Run Date: 6-20-69

TABLE D-21

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification COAL VII, SULLIVAN COUNTY, INDIANA

Zone E 3/8 Inch x 0 Run (6-20-69) Crushed to 30 Mesh x 0

BCR Sample No. 2287

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
		Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	6.6	1.90	72.5	1.16	
Zone B	40.3	0.22	62.8	1.30	
Zone C	11.7	0.28	70.6	1.36	
Zone D	36.7	0.21	63.2	8.87	22.3
Zone E	4.7	0.22	66.5	44.4	3.59
Composite of Table Products	100.0		64.67	6.10	
Analysis of Feed to Table		1.20	71.90	10.38	

Run Date: 9-29-69

TABLE D-22

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification COAL VII, SULLIVAN COUNTY, INDIANA

Zone D, 30 Mesh x 0 Run (9-29-69) Crushed to 60 Mesh x 0

BCR Sample No. 2287

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
		Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	1.3	1.36	61.6	3.00	
Zone B	5.6	0.73	60.9	3.34	
Zone C	38.1	0.22	59.6	3.71	
Zone D	47.9	0.12	67.5	9.66	18.4
Zone E	7.1	0.20	68.7	43.5	1.77
Composite of Table Products	100.0		64.13	9.36	
Analysis of Feed to Table		0.21	63.2	8.87	

Run Date: 10-2-69

TABLE D-23

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Pyrite Beneficiation - Effects of Two-stage Cleaning

Coal Identification COAL VII, SULLIVAN COUNTY, INDIANA

BCR Sample No. 2287

Pyrite Precleaning

Concentrating Table No. 14 Test Run Date 6-20-69

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	15.1	1.00
Zone E (Pyrite Zone)	1.4	71.90	10.38

Pyrite Cleaning

Concentrating Table No. 15-S Test Run Date 9-29-69

Feed to Concentrating Table: Zone E, 3/8 Inch x 0 Run (6-20-69) Crushed to 30 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	71.90	10.38
Zone E (Pyrite Zone)	4.7	66.5	44.4

Concentrating Table No. 15-S Test Run Date 10-2-69

Feed to Concentrating Table: Zone D, 30 Mesh x 0 Run (9-29-69) Crushed to 60 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	63.2	8.87
Zone E (Pyrite Zone)	7.1	68.7	43.5

Two Stage Pyrite Product	0.1	67.30	44.07

TABLE D-24

Flowsheet for Pyrite Beneficiation Tests, Phase IV

Coal VII, Sullivan County, Indiana
BCR Sample No. 2287

Pounds of Total Sulfur/Ton of
Run-of-Mine Coal

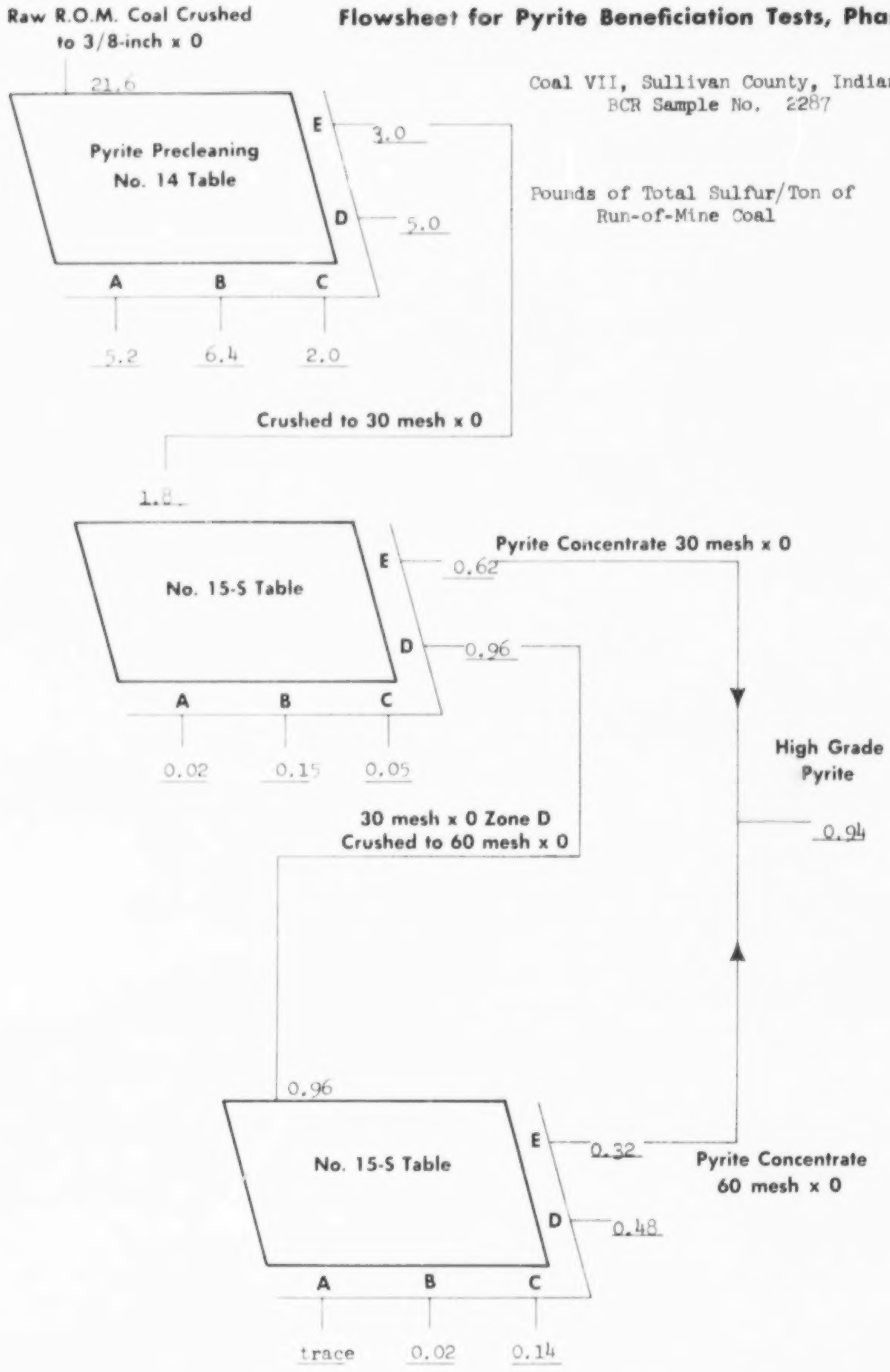

Raw R.O.M. Coal Crushed to 3/8-inch x 0
21.6
Pyrite Precleaning No. 14 Table
E
3.0
D
5.0
A
B
C
5.2
6.4
2.0
Crushed to 30 mesh x 0
1.8
No. 15-S Table
E
0.62
Pyrite Concentrate 30 mesh x 0
D
0.96
A
B
C
0.02
0.15
0.05
High Grade Pyrite
0.94
30 mesh x 0 Zone D Crushed to 60 mesh x 0
0.96
No. 15-S Table
E
0.32
Pyrite Concentrate 60 mesh x 0
D
0.48
A
B
C
trace
0.02
0.14

TABLE D-25

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Flowsheet Data for Pyrite Beneficiation Tests, Phase IV

Coal Identification COAL VII, SULLIVAN COUNTY, INDIANA

BCR Sample No. 2287

			Chemical Analysis, Dry Basis Weight Percent	
Fraction	Weight Percent		Ash	Total Sulfur
3/8 Inch x 0 R.O.M. Coal Processed on No. 14 Concentrating Table				
Zone A	34.3		15.0	0.76
Zone B	42.7		9.89	0.76
Zone C	12.4		4.51	0.80
Zone D	9.2		41.07	2.75
Zone E		1.4	71.90	10.38
3/8 Inch x 0, Zone E, Material Pulverized to Minus 30 Mesh and Processed on 15S Metallurgical Table				
Zone A	0.09		72.5	1.16
Zone B	0.57		62.8	1.30
Zone C	0.16		70.6	1.36
Zone D		0.51	63.2	8.87
Zone E	0.07		66.5	44.4
30 Mesh x 0, Zone E, Material Pulverized to Minus 60 Mesh and Processed on 15S Metallurgical Table				
Zone A	0.01		61.6	3.00
Zone B	0.03		60.9	3.34
Zone C	0.19		59.6	3.71
Zone D	0.24		67.5	9.66
Zone E	0.04		68.7	43.5
Composite of Fractions	100.0		14.62	1.03
Analysis of Feed Coal			15.1	1.00

TABLE D-26

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests--30 Mesh x 0 Deep Cleaning

Coal Identification LOWER FREEPORT SEAM, CAMBRIA COUNTY, PENNSYLVANIA

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0,
Pyrite Precleaning
BCR Sample No. 2299

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	52.4		0.42	6.62	1.48	
Zone B	22.6		0.36	7.06	1.53	
Zone C						
Float at 1.60	2.9	95.1	0.66	7.88	1.68	
Sink at 1.60	0.1	4.9	0.42	41.8	8.31	
Composite	3.0	100.0		9.54	2.00	
Zone D						
Float at 1.60	2.7	20.3	0.37	17.4	2.52	53.9
1.60 by 2.95	10.5	78.5	0.52	68.1	3.78	19.5
Sink at 2.95	0.1	1.2	0.32	65.6	32.6	10.0
Composite	13.3	100.0		57.78	3.87	26.37
Zone E						
Float at 2.95	6.7	76.7	0.47	82.0	4.81	
Sink at 2.95	2.0	23.3	0.20	62.2	41.6	
Composite	8.0	100.0		77.39	13.38	
Composite of Zones A, B, C	78.0			6.86	1.51	
Composite of 1.60 Float Fractions	80.6			7.16	1.54	
Composite of 2.95 Sink Fractions	2.1			62.36	41.17	
Composite of Table Products	100.0			19.77	2.86	
Analysis of Feed to Table			1.40	17.6	2.82	

Run Date: 10-13-69

TABLE D-27

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification LOWER FREEPORT SEAM, CAMBRIA COUNTY, PENNSYLVANIA

Zone E, 3/8 Inch x 0 Run (10-13-69) Crushed to 30 Mesh x 0

BCR Sample No. 2299

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
		Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	1.1	0.44	72.4	6.04	
Zone B	16.1	0.40	73.4	6.52	
Zone C	14.0	0.29	75.4	6.98	
Zone D	60.6	0.28	82.0	10.8	6.0
Zone E	8.2	0.10	63.9	47.2	4.6
Composite of Table Products	100.0		78.10	12.51	
Analysis of Feed to Table			77.39	13.38	

Run Date: 10-22-69

TABLE D-28

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification LOWER FREEPORT SEAM, CAMBRIA COUNTY, PENNSYLVANIA

Zone D, 30 Mesh x 0 Run (10-22-69) Crushed to 60 Mesh x 0

BCR Sample No. 2299

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
		Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	5.3	0.79	82.4	5.26	
Zone B	35.4	0.00	86.6	6.82	
Zone C	21.2	0.00	83.8	4.82	
Zone D	30.5	0.12	69.2	24.8	8.40
Zone E	7.6	0.05	67.4	43.8	4.20
Composite of Table Products	100.0		79.02	14.61	
Analysis of Feed to Table			82.0	10.8	

Run Date: 10-28-69

TABLE D-29

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Pyrite Beneficiation - Effects of Two-stage Cleaning

Coal Identification LOWER FREEPORT SEAM, CAMBRIA COUNTY, PENNSYLVANIA

BCR Sample No. 2299

Pyrite Precleaning

Concentrating Table No. 14 Test
Run Date 10-13-69
Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	17.6	2.82
Zone E (Pyrite Zone)	8.7	77.39	13.38

Pyrite Cleaning

Concentrating Table No. 15-S Test
Run Date 10-22-69
Feed to Concentrating Table: Zone E, 3/8 Inch x 0 Run (10-13-69) Crushed to 30 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	27.39	13.38
Zone E (Pyrite Zone)	8.2	63.9	47.2

Concentrating Table No. 15-S Test
Run Date 10-28-69
Feed to Concentrating Table: Zone D, 30 Mesh x 0 (10-22-69) Crushed to 60 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	82.0	10.8
Zone E (Pyrite Zone)	7.6	67.4	43.8

Two Stage Pyrite Product	1.1	65.17	45.96

TABLE D-30

Flowsheet for Pyrite Beneficiation Tests, Phase IV

Lower Freeport Seam, Cambria County, Pa.
BCR Sample No. 2299

Pounds of Total Sulfur/Ton of
Run-of-Mine Coal

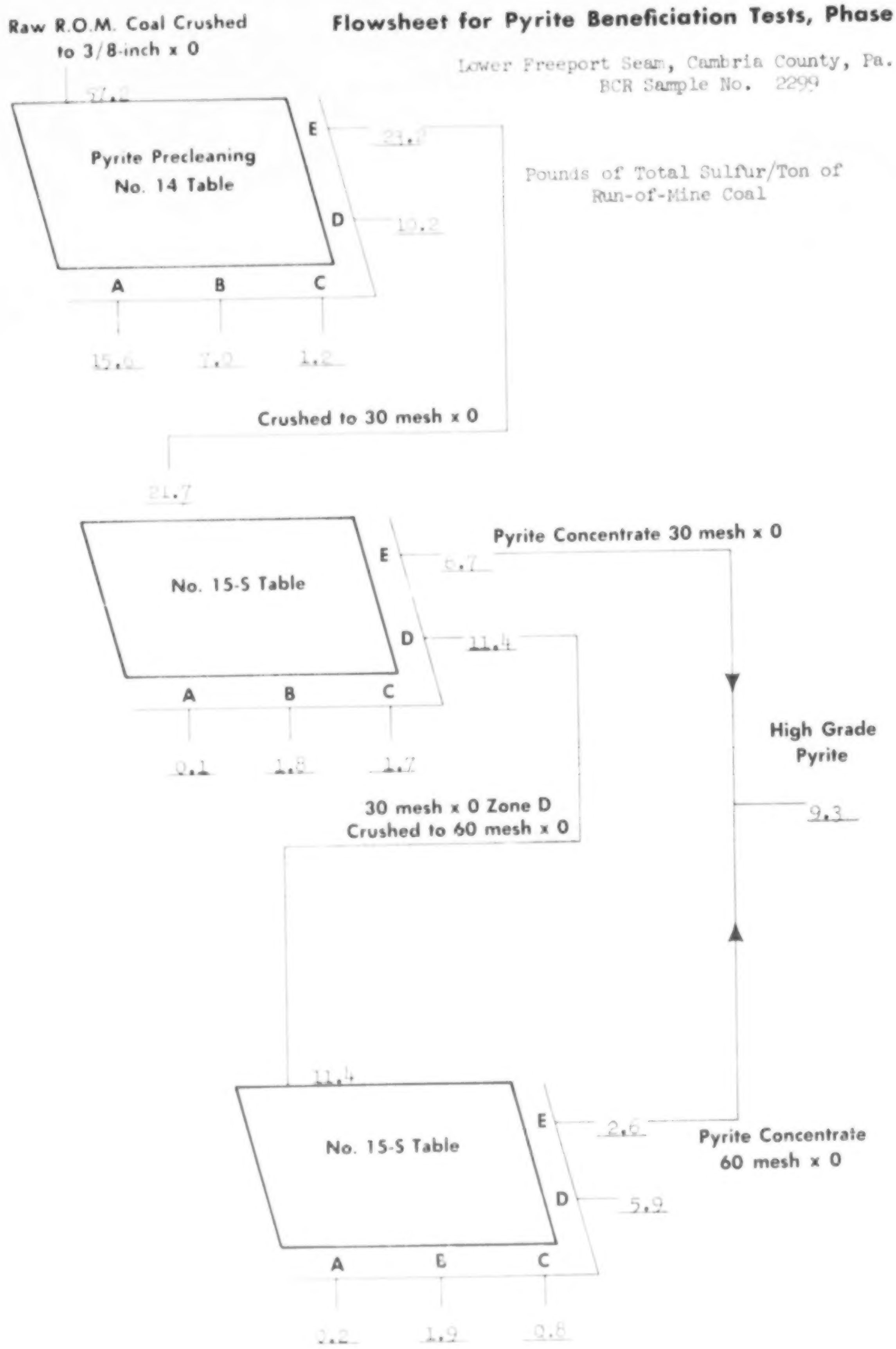

Raw R.O.M. Coal Crushed to 3/8-inch x 0
57.2
Pyrite Precleaning No. 14 Table
E
23.2
D
10.2
A
B
C
15.6
7.0
1.2
Crushed to 30 mesh x 0
21.7
No. 15-S Table
E
6.7
Pyrite Concentrate 30 mesh x 0
D
11.4
A
B
C
0.1
1.8
1.7
High Grade Pyrite
9.3
30 mesh x 0 Zone D Crushed to 60 mesh x 0
11.4
No. 15-S Table
E
2.6
Pyrite Concentrate 60 mesh x 0
D
5.9
A
B
C
0.2
1.9
0.8

TABLE D-31

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Flowsheet Data for Pyrite Beneficiation Tests, Phase IV

Coal Identification LOWER FREEPORT SEAM, CAMBRIA COUNTY, PENNSYLVANIA

BCR Sample No. 2299

Fraction	Weight Percent		Chemical Analysis, Dry Basis Weight Percent: Ash	Chemical Analysis, Dry Basis Weight Percent: Total Sulfur
3/8 Inch x 0 R.O.M. Coal Processed on No. 14 Concentrating Table				
Zone A	52.4		6.62	1.48
Zone B	22.6		7.06	1.53
Zone C	3.0		9.54	2.00
Zone D	13.3		57.80	3.87
Zone E		8.7	77.39	13.38
3/8 Inch x 0, Zone E, Material Pulverized to Minus 30 Mesh and Processed on 15S Metallurgical Table				
Zone A	0.1		72.4	6.04
Zone B	1.4		73.4	6.52
Zone C	1.2		75.4	6.98
Zone D		5.3	82.0	10.8
Zone E	0.7		63.9	47.2
30 Mesh x 0, Zone E, Material Pulverized to Minus 60 Mesh and Processed on 15S Metallurgical Table				
Zone A	0.3		82.4	5.26
Zone B	1.9		86.6	6.82
Zone C	1.1		83.8	4.82
Zone D	1.6		69.2	24.8
Zone E	0.4		67.4	43.8
Composite of Fractions	100.0		19.68	2.98
Analysis of Feed Coal			17.6	2.82

TABLE D-32

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests

Coal Identification LOWER CHEROKEE SEAM, MARION COUNTY, IOWA

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Pyrite Precleaning

BCR Sample No. 2415

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	35.3		1.16	9.78	3.54	
Zone B	17.6		0.88	7.24	3.02	
Zone C						
Float at 1.60	33.9	93.0	1.44	6.94	2.94	69.1
1.60 by 1.90	1.5	4.2	1.27	35.2	10.7	48.1
Sink at 1.90	1.0	2.8	0.84	52.0	20.8	28.6
Composite	36.4	100.0		9.39	3.77	67.08
Zone D						
Float at 1.90	2.9	65.6	3.53	9.00	3.24	66.8
1.90 by 2.95	1.4	30.6	0.92	50.9	15.5	25.7
Sink at 2.95	0.2	3.8	0.60	60.7	34.1	9.6
Composite	4.5	100.0		23.79	8.16	52.05
Zone E						
Float at 2.95	4.4	70.7	1.18	48.5	10.9	
Sink at 2.95	1.8	29.3	0.39	58.7	39.6	
Composite	6.2	100.0		51.49	19.31	
Composite of Zones A, B, C	89.3			9.12	3.53	
Composite of 1.60 Float Fractions	89.7			8.18	3.20	
Composite of 2.95 Sink Fractions	2.0			58.90	39.05	
Composite of Table Products	100.0			12.41	4.72	
Analysis of Feed to Table			6.39	12.8	5.12	

Run Date: 9-5-69

TABLE D-33

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification LOWER CHEROKEE SEAM, MARION COUNTY, IOWA

Zone E, 3/8 Inch x 0 Run (9-5-69) Crushed to 30 Mesh x 0

BCR Sample No. 2415

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
		Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	0.9	0.92	33.4	12.8	
Zone B	23.0	0.26	29.8	12.2	
Zone C	17.4	1.06	32.6	14.7	
Zone D	36.2	0.12	62.4	16.4	15.3
Zone E	22.5	0.06	64.4	44.6	5.69
Composite of Table Products	100.0		49.91	21.45	
Analysis of Feed to Table		0.95	51.49	19.31	

Run Date: 10-2-69

TABLE D-34

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification LOWER CHEROKEE SEAM, MARION COUNTY, IOWA
Zone D, 30 Mesh x 0 Run (10-2-69) Crushed to 60 Mesh x 0

BCR Sample No. 2415

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
		Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	2.2	0.49	54.3	15.2	
Zone B	14.8	0.20	53.1	15.8	
Zone C	27.2	0.10	61.2	14.9	
Zone D	50.6	0.10	64.5	15.4	4.8
Zone E	5.2	0.10	66.0	46.8	2.0
Composite of Table Products	100.0		61.77	16.95	
Analysis of Feed to Table		0.12	62.4	16.4	

Run Date: 10-22-69

TABLE D-35

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Pyrite Beneficiation - Effects of Two-stage Cleaning

Coal Identification LOWER CHEROKEE SEAM, MARION COUNTY, IOWA

BCR Sample No. 2415

Pyrite Precleaning

Concentrating Table No. 14 Test Run Date 9-5-69

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight % Ash	 Total Sulfur
Analysis of Feed to Table	100.0	12.8	5.12
Zone E (Pyrite Zone)	6.2	51.49	19.31

Pyrite Cleaning

Concentrating Table No. 15-S Test Run Date 10-2-69

Feed to Concentrating Table: Zone E, 3/8 Inch x 0 Run (9-5-69) Crushed to 30 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight % Ash	 Total Sulfur
Analysis of Feed to Table	100.0	51.49	19.31
Zone E (Pyrite Zone)	22.5	64.4	44.6

Concentrating Table No. 15-S Test Run Date 10-22-69

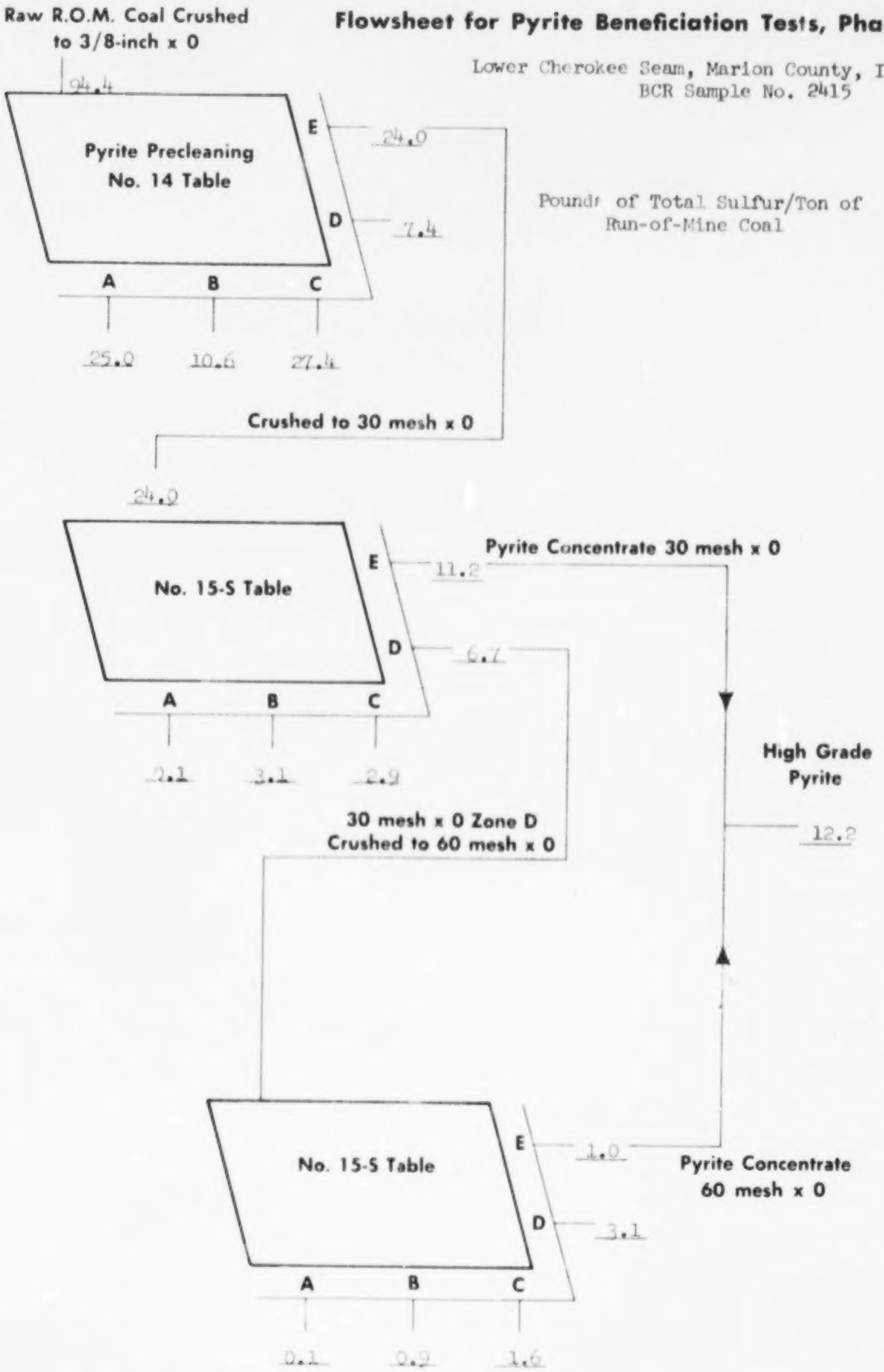
Feed to Concentrating Table: Zone D, 30 Mesh x 0 Run (10-2-69) Crushed to 60 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight % Ash	 Total Sulfur
Analysis of Feed to Table	100.0	62.4	16.4
Zone E (Pyrite Zone)	5.2	66.0	46.8
Two Stage Pyrite Product	1.5	64.5	44.7

TABLE D-36

Flowsheet for Pyrite Beneficiation Tests, Phase IV

Lower Cherokee Seam, Marion County, Iowa
BCR Sample No. 2415


Raw R.O.M. Coal Crushed
to 3/8-inch x 0
94.4
Pyrite Precleaning
No. 14 Table
E
24.0
D
7.4
A
B
C
25.0
10.6
27.4
Crushed to 30 mesh x 0
24.0
No. 15-S Table
E
11.2
Pyrite Concentrate 30 mesh x 0
D
6.7
A
B
C
0.1
3.1
2.9
High Grade
Pyrite
12.2
30 mesh x 0 Zone D
Crushed to 60 mesh x 0
No. 15-S Table
E
1.0
Pyrite Concentrate
60 mesh x 0
D
3.1
A
B
C
0.1
0.9
1.6

Pounds of Total Sulfur/Ton of
Run-of-Mine Coal

TABLE D-37

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Flowsheet Data for Pyrite Beneficiation Tests, Phase IV

Coal Identification LOWER CHEROKEE SEAM, MARION COUNTY, IOWA

BCR Sample No. 2415

Fraction	Weight Percent		Chemical Analysis, Dry Basis Weight Percent	
			Ash	Total Sulfur
3/8 Inch x 0 R.O.M. Coal Processed on No. 14 Concentrating Table				
Zone A	35.3		9.78	3.54
Zone B	17.6		7.24	3.02
Zone C	36.4		9.39	3.77
Zone D	4.5		23.79	8.16
Zone E		6.2	51.49	19.31
3/8 Inch x 0, Zone E, Material Pulverized to Minus 30 Mesh and Processed on 15S Metallurgical Table				
Zone A	0.1		33.4	12.8
Zone B	1.4		29.8	12.2
Zone C	1.1		32.6	14.7
Zone D		2.2	62.4	16.4
Zone E	1.4		64.4	44.6
30 Mesh x 0, Zone E, Material Pulverized to Minus 60 Mesh and Processed on 15S Metallurgical Table				
Zone A	0.05		54.3	15.2
Zone B	0.33		53.1	15.8
Zone C	0.60		61.2	14.9
Zone D	1.11		64.5	15.4
Zone E	0.11		66.0	46.8
Composite of Fractions	100.0		12.28	4.86
Analysis of Feed Coal			12.8	5.12

TABLE D-38

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table Tests--3/8 Inch x 0 Rough Cleaning

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI

Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0, Pyrite Precleaning

BCR Sample No. 2417

Table Products	Product Weight Percent	Float and Sink Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
			Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	38.6		1.66	18.2	4.19	
Zone B	30.3		1.20	15.7	4.36	
Zone C						
Float at 1.60	5.0	57.8	0.72	18.8	5.92	
1.60 by 1.90	2.0	22.9	0.54	37.0	9.06	35.1
Sink at 1.90	1.7	19.3	0.52	66.1	7.83	16.5
Composite	8.7	100.0		32.10	7.01	
Zone D						
Float at 1.90	0.4	3.4	1.96	22.6	5.88	58.3
1.90 by 2.95	11.6	89.8	0.70	71.4	6.44	17.2
Sink at 2.95	0.9	6.8	0.71	69.2	29.0	7.9
Composite	12.9	100.0		69.59	7.96	17.97
Zone E						
Float at 2.95	4.2	43.7	0.39	78.6	7.34	
Sink at 2.95	5.3	56.3	0.17	65.4	39.8	
Composite	9.5	100.0		71.17	25.61	
Composite of Zones A, B, C	77.6			18.78	4.57	
Composite of 1.60 Float Fractions	74.3			17.24	4.38	
Composite of 2.95 Sink Fractions	6.2			65.95	38.23	
Composite of Table Products	100.0			30.31	7.01	
Analysis of Feed to Table			2.22	29.8	6.92	

Run Date: 10-3-69

TABLE D-39

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI

Zone E, 3/8 Inch x 0 Run (10-3-69) Crushed to 30 Mesh x 0

BCR Sample No. 2417

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
		Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	8.1	0.42	72.3	15.8	
Zone B	29.2	0.51	72.3	15.2	
Zone C	15.5	0.17	77.3	12.9	
Zone D	39.0	0.10	67.2	38.6	5.8
Zone E	8.2	0.05	66.3	47.4	2.9
Composite of Table Products	100.0		70.59	26.66	
Analysis of Feed to Table			71.17	25.61	

Run Date: 10-22-69

TABLE D-40

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Concentrating Table No. 15-S Tests - Pyrite Beneficiation

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI

Zone D, 30 Mesh x 0 Run (10-22-69) Crushed to 60 Mesh x 0

BCR Sample No. 2417

Table Products	Product, Weight Percent	Chemical Analysis, Dry Basis, Weight Percent			
		Moisture	Ash	Total Sulfur	Ultimate Carbon
Zone A	2.2	0.84	68.3	2.49	
Zone B	21.2	0.08	82.2	6.44	
Zone C	26.8	0.00	69.8	33.2	
Zone D	21.4	0.20	65.8	42.8	5.1
Zone E	28.4	0.01	64.7	47.0	4.0
Composite of Table Products	100.0		70.09	32.82	
Analysis of Feed to Table			67.2	38.6	

Run Date: 10-28-69

TABLE D-41

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Pyrite Beneficiation - Effects of Two-stage Cleaning

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI

BCR Sample No. 2417

Pyrite Precleaning

Concentrating Table No. 14 Test Run Date 10-3-69

Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight % Ash	Total Sulfur
Analysis of Feed to Table	100.0	29.8	6.92
Zone E (Pyrite Zone)	9.5	71.17	25.61

Pyrite Cleaning

Concentrating Table No. 15-S Test Run Date 10-22-69

Feed to Concentrating Table: Zone E, 3/8 Inch x 0 Run (10-3-69) Crushed to 30 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight % Ash	Total Sulfur
Analysis of Feed to Table	100.0	71.17	25.61
Zone E (Pyrite Zone)	8.2	66.3	47.4

Concentrating Table No. 15-S Test Run Date 10-28-69

Feed to Concentrating Table: Zone D, 30 Mesh x 0 Run (10-22-69) Crushed to 60 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight % Ash	Total Sulfur
Analysis of Feed to Table	100.0	67.2	38.6
Zone E (Pyrite Zone)	28.1	64.7	47.0
Two Stage Pyrite Product	1.8	65.41	47.18

TABLE D-42

Flowsheet for Pyrite Beneficiation Tests, Phase IV

Tebo Seam, Henry County, Missouri
BCR Sample No. 2417

Pounds of Total Sulfur/Ton of
Raw Run-of-Mine Coal

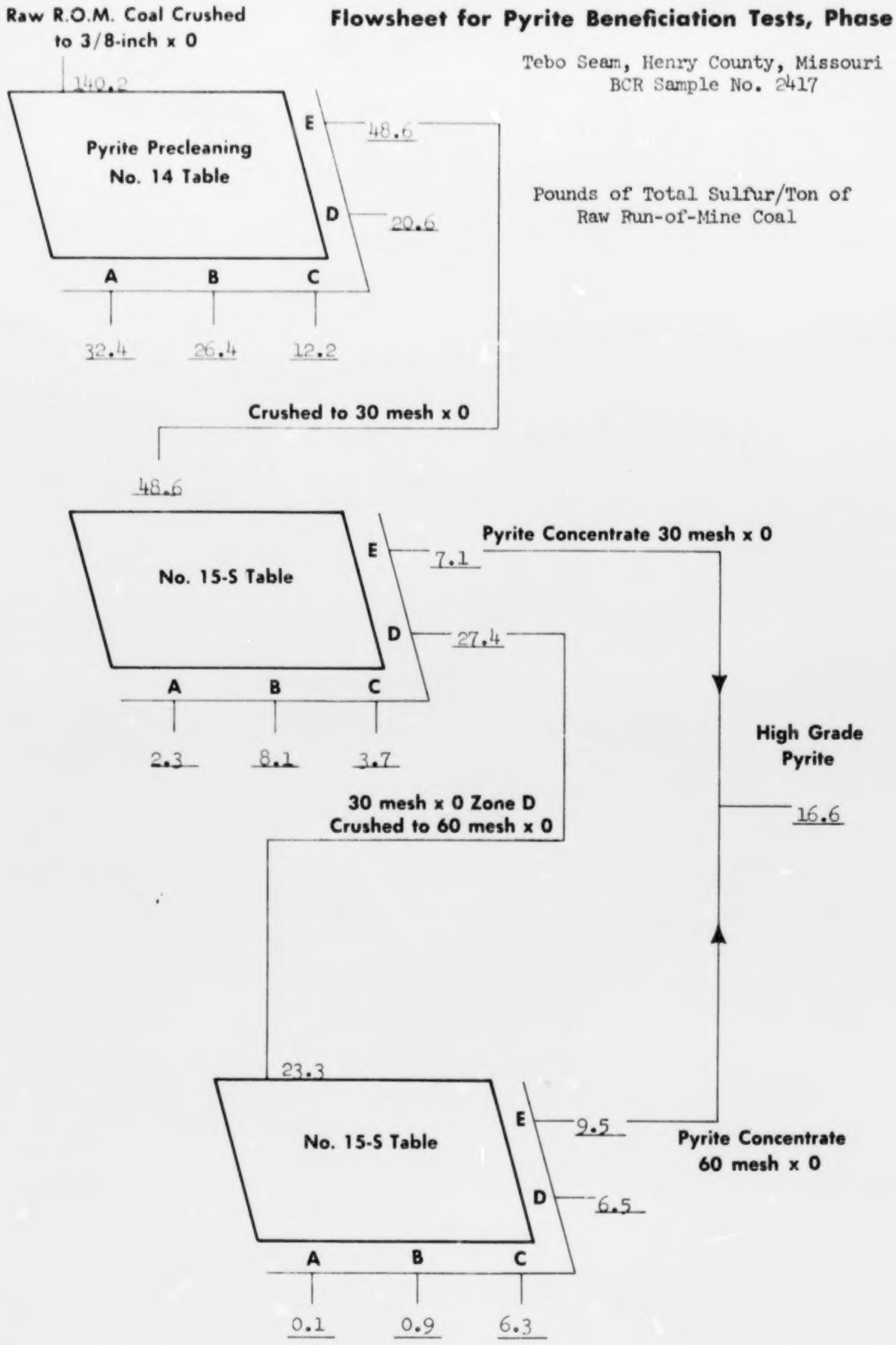

Raw R.O.M. Coal Crushed to 3/8-inch x 0
140.2
Pyrite Precleaning No. 14 Table
E
48.6
D
20.6
A
B
C
32.4
26.4
12.2
Crushed to 30 mesh x 0
48.6
No. 15-S Table
E
7.1
Pyrite Concentrate 30 mesh x 0
D
27.4
A
B
C
2.3
8.1
3.7
High Grade Pyrite
16.6
30 mesh x 0 Zone D Crushed to 60 mesh x 0
23.3
No. 15-S Table
E
9.5
Pyrite Concentrate 60 mesh x 0
D
6.5
A
B
C
0.1
0.9
6.3

TABLE D-43

Evaluation of Coal Cleaning Processes and Techniques for Removing Pyritic Sulfur from Fine Coal

Pyrite Beneficiation - Effects of Two-stage Cleaning

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI

BCR Sample No. 2417

Pyrite Precleaning

Concentrating Table No. 14 Test Run Date 10-3-69
Feed to Concentrating Table: Raw Run-of-Mine Coal Crushed to 3/8 Inch x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	29.8	6.92
Zone E (Pyrite Zone)	9.5	71.17	25.61

Pyrite Cleaning

Concentrating Table No. 15-S Test Run Date 10-22-69
Feed to Concentrating Table: Zone E, 3/8 Inch x 0 Run (10-3-69) Crushed to 30 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	71.17	25.61
Zone E (Pyrite Zone)	8.2	66.3	47.4

Concentrating Table No. 15-S Test Run Date 10-28-69
Feed to Concentrating Table: Zone D, 30 Mesh x 0 Run (10-22-69) Crushed to 60 Mesh x 0

	Product, Weight %	Chemical Analysis, Dry Basis, Weight %	
		Ash	Total Sulfur
Analysis of Feed to Table	100.0	67.2	38.6
Zone E (Pyrite Zone)	49.8	65.1	45.1
Two Stage Pyrite Product	2.6	65.5	45.8

TABLE D-44

Flowsheet for Pyrite Beneficiation Tests, Phase IV

Tebo Seam, Henry County, Missouri
BCR Sample No. 2417

Pounds of Total Sulfur/Ton of
Raw Run-of-Mine Coal

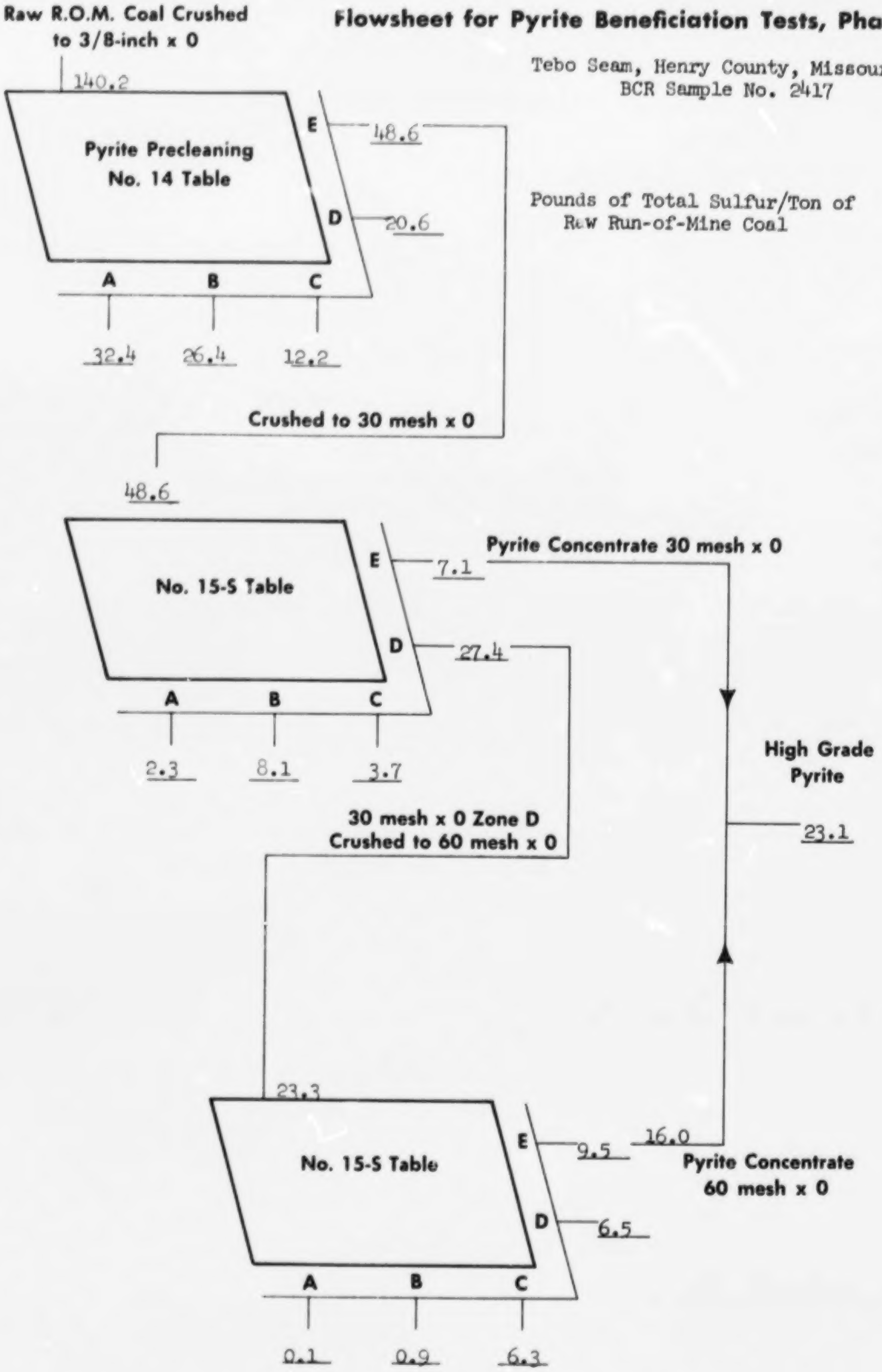

Raw R.O.M. Coal Crushed to 3/8-inch x 0
140.2
Pyrite Precleaning No. 14 Table
E
48.6
D
20.6
A
B
C
32.4
26.4
12.2
Crushed to 30 mesh x 0
48.6
No. 15-S Table
E
7.1
Pyrite Concentrate 30 mesh x 0
D
27.4
A
B
C
2.3
8.1
3.7
High Grade Pyrite
23.1
30 mesh x 0 Zone D Crushed to 60 mesh x 0
23.3
No. 15-S Table
E
9.5
16.0
Pyrite Concentrate 60 mesh x 0
D
6.5
A
B
C
0.1
0.9
6.3

TABLE D-45

Evaluation of Coal Cleaning Processes and Techniques
for Removing Pyritic Sulfur from Fine Coal

Flowsheet Data for Pyrite Beneficiation Tests, Phase IV

Coal Identification TEBO SEAM, HENRY COUNTY, MISSOURI

BCR Sample No. 2417

Fraction	Weight Percent		Chemical Analysis, Dry Basis Weight Percent Ash	Total Sulfur
3/8 Inch x 0 R.O.M. Coal Processed on No. 14 Concentrating Table				
Zone A	38.6		18.2	4.19
Zone B	30.3		15.7	4.36
Zone C	8.7		32.10	7.01
Zone D	12.9		69.59	7.96
Zone E		9.5	71.17	25.61
3/8 Inch x 0, Zone E, Material Pulverized to Minus 30 Mesh and Processed on 15S Metallurgical Table				
Zone A	0.7		72.3	15.8
Zone B	2.8		72.3	15.2
Zone C	1.5		77.3	12.9
Zone D		3.7	67.2	38.6
Zone E	0.8		66.3	47.4
30 Mesh x 0, Zone E, Material Pulverized to Minus 60 Mesh and Processed on 15S Metallurgical Table				
Zone A	0.1		68.3	2.49
Zone B	0.8		82.2	6.44
Zone C	1.0		69.8	33.2
Zone D	0.8		65.8	42.8
Zone E	1.0		64.7	47.0
Composite of Fractions	100.0		30.37	6.88
Analysis of Feed Coal			29.8	6.92